NATURE

No. 4044 SATURDAY, MAY 3, 1947 Vol. 159

CONTENTS

	Page
Development of Colonial Territories	585
Richard Jefferies and the English Farm Worker. By Sir John Russell, F.R.S.	588
A Text-book for Anæsthetists. By Prof. J. H. Gaddum, F.R.S.	588
Research in Canada. By R. Brightman	589
Acoustical Quanta and the Theory of Hearing. By Dr. D. Gabor	591
A Chemical Bicentenary at the University of Glasgow. By Dr. Andrew Kent	594
Taxonomy of Aquatic Insect Nymphs and Larvæ. By Dr. T. T. Macan	595
Obituaries :	
Prof. B. A. McSwiney, F.R.S. By G. L. Brown, F.R.S.	596
Prof. Gregori Aminoff. By Prof. G. Hägg	597
Prof. Fred Vlès. By Prof. H. Munro Fox, F.R.S.	597
News and Views	598
Letters to the Editors :	
The Upper Milk Molars of the Ape-man, *Plesianthropus*.—Dr. R. Broom, F.R.S.	602
Normal Development of Fertilized Rabbit Ova Stored at Low Temperature for Several Days.—Dr. Min-Chueh Chang	602
Hyaluronidase in Sea-Urchin Sperm.—Dr. A. Monroy and A. Ruffo	603
Mutations in *Drosophila* Induced by a Carcinogen.—M. Demerec	604
Selective Mating as a Factor for Speciation in Cichlid Fish of East African Lakes.—Prof. Curt Kosswig	604
Feeding Mechanism of Water-Bugs.—H. D. Slack	605
Effects of High Temperature and Short Days on Vernalization Response of Summer Varieties of Rice.—Dr. S. M. Sircar and B. N. Ghosh	605
Sunflower Stem Cultures for the Detection of Plant Hormones.—R. S. de Ropp	606
Sex Differences in Colour Vision.—Dr. R. W. Pickford	606
The Name 'Penicillin'.—Dr. Frank H. Stodola	607
Emission of Secondary Charged Particles in Fission.—Prof. N. Feather, F.R.S.	607
Spontaneous Fluctuations of Current in a Photo-Electric Cell.—Dr. R. Fürth and Dr. D. K. C. MacDonald	608
Identification by X-Rays of Interface Compounds on 'Oxide' Cathodes.—H. P. Rooksby	609
Crystal Structure of $Co[Hg(CNS)_4]$.—J. W. Jaffery	610
Effect of Shape of Operating Chamber in the Freeze-drying Process.—A. J. Ede	610
Velocity of Electromagnetic Waves.—Dr. L. Essen	611
Resolution of Mepacrine.—B. R. Brown and D. Ll. Hammick	612
Polymerization of a Semiquinone Ion.—G. K. Hughes, N. Hush and D. P. Mellor	612
Size Versus Colour in Air-Sea Rescue.—Dr. W. R. G. Atkins, O.B.E., F.R.S.	612
Chemical Effects of Moonlight.—Dr. Elizabeth Sidney Semmens	613
Research in British Colonial Territories	614
Reports of the Atomic Energy Commission	616
Hormones and Fruit-Fall. By Dr. John Grainger	617
Biochemistry in Belgium	617

Editorial and Publishing Offices
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.
Telephone Number : Whitehall 8831
Telegrams : Phusis Lesquare London
Advertisements should be addressed to
T. G. Scott & Son, Ltd., Talbot House, 9 Arundel Street, London, W.C.2
Telephone : Temple Bar 1942
The annual subscription rate is £4 10 0, payable in advance, inland or Abroad

All rights reserved. Registered as a Newspaper at the General Post Office

DEVELOPMENT OF COLONIAL TERRITORIES

THE many-sidedness and complexity of research in the overseas territories of Great Britain are well illustrated in the five annual reports recently published under the title "Colonial Research", a digest of which appears on p. 614 of this issue; but fears that such research is over-organised or centralized excessively should be dispelled by the whole tenor of these reports. In the report of the Colonial Research Committee, in particular, it is observed that it, and the specialist committees in their particular fields, are not to be regarded as the sole fount and origin of all projects of research, and that it would be unfortunate if their mere existence were in any way to inhibit initiative on the part of other agencies or individuals who may have in mind projects of potential interest or value. On the contrary, the Committee would cordially welcome proposals from any source, and will be glad to consider recommending financial assistance toward their execution. As the Colonial Research Committee rightly points out, the scientific needs of the Colonies are too wide and too complex to be made the preserve of any single organisation of committees, and initiative and interest in these fields cannot be too widespread.

It is in keeping with this, and with the further fact that many of the problems, as these reports well illustrate, are regional in scope, that there is already a marked tendency towards collaboration across not merely Colonial but also national frontiers. Such collaboration is increasingly tending to take place at the technical and scientific level, and this may well prove an important factor in promoting closer political understanding and co-operation. Moreover, a second point made by the Colonial Research Committee in this, its third, annual report is of importance in the same connexion. In many fields the problems to be solved at the present stage themselves require accurate identification and definition before they can be profitably investigated. The Committee is therefore disposed to favour projects which have as their immediate objective the exploration and identification of problems, rather than intensive investigations.

Such background research, which enables the scientific problems of the Colonies to be seen in proportion, and general research plans to be framed with some confidence that emphasis is being placed in accordance with actual needs, is, in the Committee's view, required in much greater measure than in the past. Pilot surveys and preliminary studies of this type are in fact no less suitable for co-operation on a regional basis than those intensive investigations on well-defined problems where the value of international co-operation has been so effectively demonstrated during the last three decades.

While the other reports do not discuss the wider aspects of Colonial research in quite the same way or in general terms, such aspects are clearly being kept in mind, as is shown, for example, by the incidental comment of the Colonial Products Research Council that the promising work of evaluating the

medicinal properties of many Colonial vegetable products would be gravely handicapped but for the ready co-operation of the Medical Research Council. Again, the general policy adopted by the Colonial Medical Research Committee of trying to obtain men with the initiative and originality necessary for good research, and encouraging them to choose their own problems and their own methods of approach, is well calculated to stimulate creative work of the standard most desired. The five reports, indeed, suggest that none of the Committees is unmindful of Rutherford's conviction that an academic atmosphere, with complete freedom to follow whatever paths of investigation seem desirable or necessary, is essential for progress in fundamental science.

Whether the Committees will be able to avoid, in present circumstances, what Rutherford regarded as such a grave mistake, namely, the tempting of men with high abilities for academic research into industrial or State laboratories, remains to be seen. Assuredly the most fruitful use of the available scientific man-power of Britain will tax the utmost wisdom of the administrator—be he man of science or layman—during the next decade, and the general attitude of these Research Committees as disclosed in these reports is reassuring. The matter is all the more important as the whole trend of Colonial developments, whether under the influence of the Trusteeship Council of the United Nations, or stimulated by such schemes as the plan for the production of ground-nuts in Tanganyika, Northern Rhodesia and Kenya resulting from an official mission to East Africa (Cmd. 7030. H.M. Stationery Office. February 1947. 1*s.* net), is likely to increase the demand both for research schemes and for scientific men in research and development work.

The high importance of this bold and comprehensive scheme for the development of backward territories must be stressed. Its potentialities for meeting the serious threat of famine which now faces East Africa, and to supply food, other than the fats primarily intended for the outside world, have attracted public attention to an extent which rather overshadows those aspects with which the scientific worker is more directly concerned. Even from the point of view of the difficulty which will be experienced in obtaining the staff and equipment required for success, it is important that the scheme should be carefully studied by men of science themselves. It is estimated, for example, that the permanent operation of the project will require about 750 Europeans, and this figure includes, in addition to unit managers and engineers, such specialists as surveyors, soil conservation experts, medical men and welfare superintendents as well as scientific staff. The project outlines a comprehensive research programme, both in regard to the use of land, and the human problems of nutrition.

The scheme is primarily intended to meet the critical shortage of oils and fats, amounting for Britain alone to an annual deficiency equivalent to one and a half million tons of ground-nuts; and although the present acute phase may have passed in four or five years, expert opinion predicts a continuing world shortage for the next ten to twenty years. The position can only be substantially improved by the most highly mechanized forms of agricultural development, and the scheme proposes to take a total area of 3,210,000 acres of waterless, almost uninhabited, fly-infested country, and convert it by mechanized units of 30,000 acres into a healthy farming region producing by 1950–51 a minimum of 600,000 tons of ground-nuts annually. Of the 107 units, eighty are proposed for Tanganyika Territory, seventeen for Northern Rhodesia and ten for Kenya. All the resources of modern scientific agriculture will be employed, and when the units have been brought into production, the farming operations will need a permanent labour force of 32,100 Africans, while at the peak of operations in 1949 and 1950, some 25,000 Africans will be required for bush-clearing alone.

This gigantic undertaking, with which the Government has already decided to proceed on the general lines recommended by the mission, is one of the most stirring examples of the contribution which science can make to human welfare. Apart from its importance in meeting the world's dietary needs of fats and the African need for subsistence, its economic and social effects are likely to be far-reaching. Local plans for development and welfare will be aided by the mass production of ground-nuts, particularly in regard to the clearing of tsetse-infested bush and the control of sleeping sickness, the establishment of water-supplies, the improvement of communications, and the provision of an economic foundation for social advance.

The latter aspect merits a little more detailed consideration. Reflecting the broader tendencies of modern thought, the project rules out private enterprise as permanent owners or operators. The United Africa Co., which is undertaking the initial work, will be replaced by a public corporation sponsored and financed by the British Government, but with provision for the project to be taken over ultimately, first by the local Governments and eventually by the African communities themselves. Incidentally, the project paves the way for the eventual institution of the co-operative use of land, and it is this emphasis on the community rather than the transformation from primitive to scientific methods of cultivation that marks the truly revolutionary character of the scheme.

What has been lacking in most of the development and welfare schemes for the Colonial territories under the 1940 Act is evidence that development will proceed fast enough for the Colonies to carry their own burden of social services in the near future. Generally, the Colonies are being encouraged to plan for a higher standard of living before it is clear whether they will be able to maintain it. The danger is most apparent in the West Indies; but the present scheme, which involves a capital expenditure of about £24,000.000 spread over six years, well illustrates what is needed in order to raise standards of living.

The decision of the British Government to accept the financial risks of this scheme removes the main difficulty of securing the greater capital investment

needed in the majority of development and welfare schemes, and while the scheme is as financially sound as expert foresight can make it, the reservation that agricultural development on the scale and of the type contemplated in the mission's report has not been attempted hitherto in tropical countries adds to, rather than subtracts from, the credit due to the Colonial Office for its initiative. Moreover, the scheme is only one of several measures taken by the Government. A public utility company has been formed to take over the whole of the electricity supply of Nigeria, and the Cameroons Development Corporation will cultivate 250,000 acres on a communal basis, growing rubber, bananas and oil-palms, while all mineral rights in the Colonies are to be nationalized.

This plan for East and Central Africa is thus an example of the kind of work which the Colonial Office will be called upon to undertake in increasing measure in the scientific and concurrent pursuit of the twin aims of development and welfare. Coming at a time when the Trusteeship Council of the United Nations has commenced its task of ensuring the progressive advancement of the many millions of non-self-governing peoples inhabiting the trustee territories, it indicates that, in the Colonial revolution now proceeding, Great Britain will be in the van of progress, and that neither boldness nor imagination will be lacking from her administration of dependent territories. The dual mandate conception of Lord Lugard has entered on a further phase, and one in which the contribution of science will be of growing importance.

This is brought out specifically in two sections of the report itself. Observing that the opportunity which the project provides for introducing measures for the prevention of disease and for desirable standards of nutrition, the report urges that the possibilities should be brought to the notice of the Medical Research Council and its Human Nutrition Research Unit. Similarly, the Colonial Social Science Research Council may wish to consider the wider implications of the project, while the report envisages the creation, at the outset, of a research section of the undertaking, and in accepting the scheme the Government slightly increased the provision for central administration and research installations. The primary task of the research section in the earlier years will be to conduct research and trials to facilitate the maximum economic production of ground-nuts by the use of liming materials, fertilizers, suitable varieties, methods of soil conservation and rotation, and for the control of disease. This work can be planned in such a way as to provide basic data on problems of soil crops in East Africa, thus aiding research on these problems undertaken in the East African Agricultural Departments and at the Central Research Station for East Africa at Amani.

In later years, work in these fields will be extended to include more fundamental aspects. Studies of the production of other food crops, for example, should be linked with nutritional studies and planning, if the project is to make its fullest contribution to the solution of African problems. Veterinary problems will arise as control of the tsetse fly makes possible the introduction of animal husbandry, while, as social and economic research and planning become important, the investigation of natural resources and power supplies for industrial development would follow.

The scientific programme contemplated for the first two years includes meteorology, soil fertility studies, soil survey and mapping, crop disease survey and variety testing. A central meteorological station will be required at each main centre, and appointment of an entomologist with ecological training for study of the tsetse fly, especially in relation to bush clearance and other problems, is desirable. A pathological laboratory will be necessary for the medical service, and a nutrition adviser should be appointed, as well as a statistician and a soil chemist, competent, in conjunction with the surveying of the units, to carry out the mapping of the main soil types in the areas concerned.

For the third year the programme envisages the continuance of fertilizer work and study of the effect of incorporating humus and of conservation work on the moisture content of the soil, as well as experiments on crop rotations, including studies of the fate of nutrient elements in the soil, particularly nitrogen. The testing of alternative fertilizer materials and methods of application; the suitability of local materials for fertilizer manufacture and other industrial purposes; the investigation of water conservation problems, including drainage, on a 'geographical' scale; positive programmes of plant-breeding for resistance to disease and yield of oil; and the acclimatization of new crops, particularly of fruit and vegetables, are other directions in which research is regarded as likely to yield results of value to East Africa as a whole. In the veterinary field, studies of cattle nutrition are contemplated, and pasture studies should develop from the botanical survey of the earlier years.

This programme indicates the fundamental importance of the contribution of science to the success of the scheme, and on that ground alone the proposals and the report formulating them merit careful study by scientific workers concerned with these fields. Beyond this and beyond the importance of co-operation between men of science and scientific departments in many fields—the Rhodes – Livingstone Institute, as well as the Colonial Research Committee, the Medical Research Council and several Government Departments are all in a position to make invaluable and indispensable contributions—there is the great human interest which is attached to this experiment in human welfare. It is a programme the implications of which reach far beyond the Colonial field itself, and may provide a demonstration of the power of science to contribute to the improvement of standards of living and to increase the resources of mankind. It may open up increasing possibilities in the use of science for the welfare and not the destruction of mankind, and the fulfilment of the hopes which the vision and imagination of such schemes as the Tennessee Valley Authority and the Food and Agriculture Organisation of the United Nations have already raised.

RICHARD JEFFERIES AND THE ENGLISH FARM WORKER

A Classic of English Farming

Hodge and his Masters. By Richard Jefferies. Edited and with an Introduction by Henry Williamson. Pp. 340. (London: Faber and Faber, Ltd., 1946.) 10*s*. 6*d*. net.

IN 1872 there appeared in *The Times* a long and remarkable letter describing the life of a Wiltshire farm labourer. It was so different from the current ideas on the subject that it was drastically criticized by the *Liverpool Mercury*: "A Mr. Richard Jefferies, dating from Coate Farm, Swindon, has managed somehow or other to get two columns and a quarter of the *Times* to air his notions in, and very funny notions they seem to be—there is no doubt that he has moved about amongst hundreds of labourers; but that he has ever adequately seen them in the sense of understanding and knowing them we should be very slow to believe". But Jefferies was not crushed, and seven years later, in 1879, he wrote a series of articles on country life which were published in book form in 1880 under the title "Hodge and his Masters". For some reason or other the book was not re-issued until 1937. Messrs. Faber and Faber have now re-published it with an introduction by Mr. Henry Williamson, who has wisely reprinted the original *Times* letter and the *Liverpool Mercury's* criticism thereon.

The book was well worth reprinting, for it gives a graphic picture of the Wiltshire countryside in the 1870's, written in Jefferies' usual limpid style and with his unerring instinct for getting at the essentials and yet including sufficient detail to make the picture vivid. He attempts no running narrative; each chapter is self-contained and almost independent of the rest, and there is no final summing up. But all the same, the account is wonderfully clear, and all of Hodge's 'masters' are described in their turn. Hodge is, of course, the farm worker; the masters are the farmer, the squire, the parson, the County Court officials, and at the end, the Board of Guardians, for Hodge, much against his will, ended his days in the workhouse; his wife was dead, his children had emigrated, and the Guardians were precluded from giving outdoor relief by the circumstances that Hodge had saved a little and become part owner of his cottage.

The book was written in 1879—the worst season on record because of heavy persistent rain from haytime to harvest and beyond. The results were disastrous: the corn gave wretchedly low yields of very poor quality, the land became smothered in weeds, hay became scarce and very dear, the grass was sodden and of desperately poor feeding value, livestock were ill-nourished and disease was widespread. All this is vividly described, but not too gloomily, for there is a stolidity about the countryman, which Jefferies faithfully reproduces, that makes him slow to recognize disaster. Had 1879 stood alone, the damage might well have been repaired, but it was followed by a run of bad seasons and, worse still, wheat began to pour in from North America in unregulated flow, and meat followed suit, so that prices fell and many farmers were ruined. The chapter "Going Downhill" is one of the saddest in the book.

The vividness with which the essential features are described gives the book a very modern feeling. Over and over again one is tempted to forget that it was written in 1879 and not in 1946. The stress laid on the need for mechanization, the talks about artificial manures and hay-driers, the man who, having acquired wealth in the city, sets up as a farmer and proceeds to introduce business methods, but becomes for half the countryside an object of lawful plunder—and loses heavily in consequence—all these appear just as they would if Jefferies had been writing to-day. Happily the modern changes in the countryside, some good, some bad, have not destroyed its fundamental good features. Perhaps most important of all, the sense of responsibility to the land, the live-stock and the community remains; fortunately indeed for us, for it has meant that the output per man-year has increased since 1939 by some 17 per cent, and throughout all that critical period there was no threat of action by the workers against the community. No other primary producers can show such a record: if they could, the nation would not be in its present predicament.

The book can be strongly recommended to all lovers of the English countryside. If a second edition is called for, we hope that editor or publishers will tell us more about Richard Jefferies, for, sad to say, many young people to-day know very little about him; some indeed have never heard of him. But his work deserves to live.

E. JOHN RUSSELL

A TEXT-BOOK FOR ANÆSTHETISTS

The Chemistry of Anaesthesia

By Dr. John Adriani. Pp. ix+530. (Oxford: Blackwell Scientific Publications, Ltd., 1946.) 35*s*. net.

MEDICAL men seeking special qualifications as anæsthetists are expected to acquire a good knowledge of the basic sciences on which anæsthesia depends. A pair of text-books on the physics and chemistry of anæsthesia for use by intending anæsthetists has been published by Blackwell Scientific Publications of Oxford. The author of the present volume, John Adriani, is director of the department of anæsthesia in the Charity Hospital of Louisiana at New Orleans.

The first hundred pages are devoted to inorganic chemistry, including the physical and chemical properties of the gases present in the atmosphere, the principles of flowmeters, absorption apparatus and other equipment used by anæsthetists.

The next two hundred pages give a detailed account of the chemical properties of general anæsthetics and of other drugs used by anæsthetists, including hypnotics, opium alkaloids, local anæsthetics, drugs affecting the autonomic system and analeptics. There are a number of tables giving the chemical formulæ of allied drugs in a form which makes it easy to compare them with one another. This section of the book will be useful for reference, but it is to be hoped that anæsthetists will not be expected to memorize all these detailed facts, most of which will be of little direct use in the practice of their art.

The last two hundred pages deal with the pharmacology of general anæsthesia, with a chapter on local anæsthesia and another on enzymes, vitamins and hormones. This section will be more valuable to anæsthetists than the rest of the book and may interest readers of *Nature*. The various theories of

narcosis are impartially set forth. The effects of anæsthesia on the body fluids are discussed, with sufficient information on biochemistry to make the discussion intelligible to those medical men who have forgotten most of what they learned in the earlier parts of their time as students. Chapters are devoted to the physiology of the liver and the kidneys, with an account of the effects of anæsthetics upon them. There is a short account of methods used to estimate the effect of anæsthetics on tissues, and of the fate of anæsthetics in the body.

The book will probably find a market because it provides the information required for one type of examination in a form that is not otherwise available; but it contains a number of errors. For example, the formula on p. 235 for the rate of disappearance of an anæsthetic in the body must surely have been incorrectly copied. The numbering of atoms in the purine ring on p. 278 is not the usual one and does not correspond with chemical names in the text. On p. 289 a unit of pituitrin is defined as the amount required to raise the blood pressure of a dog by 30 per cent. Anyone who knows anything about biological assays is likely to be deeply shocked at this last statement.

There are forty-five pages of reference at the end, arranged according to the chapter, or part of a chapter, in which each work is mentioned. This system is not uncommon, but inconvenient. The reader who wishes to trace a reference must first find out which chapter he is reading by noting the page and referring to the list of contents at the beginning. He must then find the corresponding section of the list of references, and if he opens the book in the middle of one of these sections there is no indication whether he should turn on or back. This list would be easier to use if it contained, on each page, the numbers of the corresponding page of the text.

J. H. GADDUM

RESEARCH IN CANADA

Research in Canada

Planning for the Coming Years. Papers given at the Symposium of the Chemical Institute of Canada, Quebec City, June 1945. Pp. vii + 160. (Sarnia, Ont.: Imperial Oil, Ltd., 1946.)

THE papers in this volume, sponsored by Imperial Oil, Ltd., were presented at the first annual conference of the Chemical Institute of Canada, held at Quebec in June 1945, and although, as might be expected, of uneven merit, afford a conspectus of scientific research in Canada in some respects broader than that given by the annual reports of the National Research Council. Dr. C. J. Mackenzie's contribution, "Government Sponsored Research", goes far beyond the narrower limits which his position as president of that Council might impose, and he discusses the particular problem of the industrial research association in Canada in view of the relatively few large industrial units in Canada. Dr. Mackenzie looks forward to the activities of Government-sponsored laboratories, such as those of the National Research Council, being directed almost exclusively to the more fundamental aspects of applied research; but he indicates that in the meantime the National Research Council will foster industrial research either on a co-operative basis or through agencies of the type of the Mellon Institute. Dr. R. K. Stratford, chief research chemist of Imperial Oil, Ltd., in his contribution "The Co-ordination of Research in Canada", also discusses the relations between fundamental and applied research, emphasizing the importance of maintaining a reasonable balance between the man-power engaged in industrial research and in fundamental research in the universities; and he suggests the establishment of technical institutes to help co-ordinate and improve the efficiency of technical men engaged in field service or development work, a suggestion which is elaborated in some detail by Prof. P. Rion.

"The Role of the Universities in Research" is discussed more particularly by Prof. L. Thomson, who endorses Dr. Stratford's view as to their primary importance, but emphasizes that they are equally the source of expert personnel required in government and industry. Prof. Thomson goes on to emphasize the factors on which the effectiveness of the universities both for teaching and research depend, and stresses not only adequate financial support but also the provision of conditions of service to attract the best men, as does Mr. G. E. Jackson in a paper on "The Provision of Manpower for Research in Canada". Much in these and in the other papers reiterates points made repeatedly in discussions on scientific and industrial research in Great Britain in recent years and in the Barlow Report on scientific staff.

The most interesting paper is possibly that by Dr. H. G. Fox on "Research and Invention in the Law of Patents", in connexion with which attention may be directed to Mr. C. Hollins' discussion of "Patentable Invention" (*Chemistry and Industry*, 170; 1945). After dismissing as invalid in the light of Canadian experience Mr. Wendell Berge's assertion that patents have been used to stifle new enterprise and to limit capacity and production, he proceeds to review the Canadian patent system in relation to research. The situation, he holds, is not entirely satisfactory, first because of faulty administration, due largely to inadequate staffing and parsimonious grants from the Canadian Government—weaknesses which, incidentally, are obvious even outside Canada to anyone who has had dealings with the Canadian Patent Office—and, second, because of its insistence upon invention as a basis of grant of a patent. Dr. Fox develops at some length the implications of this doctrine, which he regards as inimical to organised research and team-work. He agrees that to provide the judges in patent cases with a panel of scientifically or technically qualified persons, as suggested by the Joint Chemical Committee, would assist; but urges that the only satisfactory solution is reform of the law itself to eliminate the criterion of invention and replace it by that of improvement, providing protection where a contrivance or discovery is new and useful, contributing something to the technique of scientific or industrial life or representing a step forward in art. Dr. Fox's history of the outlook on subject-matter is valuable and interesting; but it should be observed that the decline in patent activity illustrated by the graph on p. 86 and referred to on p. 115 is not peculiar to Canada. A corresponding decline is apparent at least up to 1939 in the major industrial countries, including the United Kingdom and Germany as well as the United States. Two minor corrections should be noted. The reference on p. 117 should be to the Trade Marks, Patent and Designs Federation, Ltd., while on p. 118 "Joint Chemical Society" should read "Joint Chemical Committee".

R. BRIGHTMAN

Annuaire astronomique et météorologique Camille Flammarion pour 1947

(83e année.) Pp. 381. (Paris: Ernest Flammarion, 1947.) 160 francs.

THE *Annuaire* for 1947 follows the usual plan of earlier issues, with a few minor modifications, and maintains its excellent standard. It may be pointed out that amateur astronomers, who are playing an increasing part in astronomical developments, would find this publication a very useful handbook as complementary to the "Nautical Almanac". Much of the information is tabulated in a very concise and convenient manner, and also various branches are dealt with which are outside the scope of the "Nautical Almanac". Thus, lists of comets, meteor radiants, distances, spectral classes, temperatures, diameters of stars, of variable stars, etc., and also interesting phenomena for each day, provide very handy material for amateurs who might otherwise find it necessary to search different books of reference for such information. Members of the British Astronomical Association, who depend on the Association's Handbook for data on different sides of astronomy, would find the *Annuaire* a useful addition to their bookshelves. Star maps for each month of the year will prove acceptable to many readers.

The portion dealing with terrestrial magnetism and meteorology is very short, the latter occupying less than three pages. One wonders whether this could not be enlarged a little, with some advantage to certain readers. As pointed out, however, on p. 19, it is very unlikely that this will be done in the near future, and only in so far as meteorology makes substantial progress can it claim the right to be included in the *Annuaire*. Four pages are devoted to the physics of the earth, and these deal solely with seismic disturbances in France and other countries.

M. D.

General Chemistry

By Prof. Eugene P. Schoch, Prof. William A. Felsing and Prof. George W. Watt. (International Chemical Series.) Pp. xiii+540. (New York and London: McGraw-Hill Book Co., Inc., 1946.) 20*s*.

THIS is an elementary text-book on the lines of most good American works of its kind. The material is presented in a selected order, in many cases the elements being separated from their compounds in different chapters, and there is emphasis on industrial uses. The chapters on physical chemistry are interspersed among those on inorganic chemistry, and on the whole the book lays more emphasis on this side. In some cases the sections on inorganic chemistry are very short, ozone having only one page, for example. There is a whole chapter on nuclear chemistry, and four chapters on selected topics in organic chemistry. There are references to American literature, and questions, at the ends of the chapters.

Since the book is in a second edition, it is in general accurate, but a few slips were noticed. It is surely incorrect to emphasize so strongly (p. 40) that a catalyst in a reaction "has not been altered in any way", and this is probably incorrect for the reaction dealt with. Chlorine dioxide does not, as was proved by the American chemist Bray long ago, react with water to form chlorous and chloric acids (p. 397, where the formula of chlorine dioxide is given as Cl_2O in the equation). The old chain formulæ of the sugars are given (p. 480). The portrait on p. 491 is of the wrong Perkin.

These are trifling errors, and the book as a whole is carefully written and based on modern theory. The sections on oxidation-reduction reactions, acids and bases, and electrochemistry may be mentioned as especially good. Although the book would be found interesting by teachers, it would not fit into English courses; some subjects are dealt with too summarily, and some in much too detailed a way.

Tables of the Modified Hankel Functions of Order One-Third and of their Derivatives

By the Staff of the Computation Laboratory. (Annals of the Computation Laboratory of Harvard University, Vol. 2.) Pp. xxxvi+235. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1945.) 10 dollars. 55*s*.

THE new I.B.M. Automatic Sequence Controlled Calculator at Harvard was recently described in *Nature* (**158**, 567; 1946). The volume now before us contains the first of a series of tables produced by the machine in its spare time!

The differential equation the solutions of which are tabulated is that of Stokes, namely,

$$\frac{d^2u}{dz^2} + zu = 0,$$

which occurs in problems of wave propagation. Solutions of this equation for real z have recently been tabulated under the direction of J. C. P. Miller (B.A. Mathematical Tables, Part-Volume B, 1946) as the Airy integral.

Although the general solution of this equation can be written in terms of Bessel functions of order one third, the direct tabulation, as is here done, is preferable. The real and imaginary parts of two fundamental solutions are given to eight decimals at intervals of 0·1 in x and y up to $|x + iy| \leqslant 6$.

The next tables to appear in this series are of $J_n(x)$ at a fine interval and to high values of n and x.

L. J. COMRIE

Characterisation of Organic Compounds

By Dr. F. Wild. Pp. viii+306. (Cambridge: At the University Press, 1947.) 18*s*. net.

ADVANCED students of organic chemistry and also research workers in this field will find in Dr. Wild's book a useful and comprehensive guide in the characterization and identification of organic compounds belonging to most of the ordinary types. The work is essentially for use in the laboratory; it affords practical details, either directly or through references to the literature, for the preparation of suitable derivatives and of the special reagents needed; and there are reference tables for each important type of characterizing compound described. Details for the preparation and application of some of the newer and less familiar reagents are particularly useful. As an example of the treatment adopted, the preparation of solid derivatives of alcohols is described, within the compass of eleven pages, by means of esterification with acid chlorides, isocyanates, azides, acid anhydrides and pseudo-saccharin chloride; several miscellaneous methods follow. An appended table gives the boiling-point or melting-point of the original substance and of a maximum of fourteen derivatives for a list of fifty-seven alcohols. The book is well documented, indexed and printed. An introductory section contains eleven diagrams of apparatus.

J. R.

ACOUSTICAL QUANTA AND THE THEORY OF HEARING

By Dr. D. GABOR

British Thomson-Houston Co. Research Laboratory, Rugby

IN popular expositions of wave mechanics, acoustical illustrations have been used by several authors, with particular success by Landé[1]. In a recent paper on the "Theory of Communication"[2] I have taken the opposite course. Acoustical phenomena are discussed by mathematical methods closely related to those of quantum theory. While in physical acoustics a new formal approach to old problems cannot be expected to reveal much that is not already known, the position in subjective acoustics is rather different. In fact, the new methods have already proved their heuristic value, and can be expected to throw more light on the theory of hearing. In my original paper the point of view was mainly that of communication engineering; in the following survey I have emphasized those features which may be of interest to physicists and to physiologists.

What do we hear? The answer of the standard text-books is one which few students, if any, can ever have accepted without a grain of salt. According to the theory chiefly connected with the names of Ohm and Helmholtz, the ear analyses the sound into its spectral components, and our sensations are made up of the Fourier components, or rather of their absolute values. But Fourier analysis is a timeless description, in terms of exactly periodic waves of infinite duration. On the other hand, it is our most elementary experience that sound has a time pattern as well as a frequency pattern. This duality of our sensations finds no expression either in the description of sound as a signal $s(t)$ in function of time, or in its representation by Fourier components $S(f)$. A mathematical description is wanted which *ab ovo* takes account of this duality. Let us therefore consider both time and frequency as co-ordinates of sound, and see what meaning can be given to such a representation.

If t and f are laid down as orthogonal co-ordinates, a diagram is obtained which may be called an 'information diagram' (Fig. 1). A simple harmonic oscillation is represented by a vertical line with abscissa f, a sharp pulse (delta function) by a horizontal line at the 'epoch' t. These are extreme cases. In general, signals cannot be represented by lines; but it is possible to associate with them a certain characteristic rectangle or 'cell' by the following process, which at first sight might perhaps appear somewhat complicated.

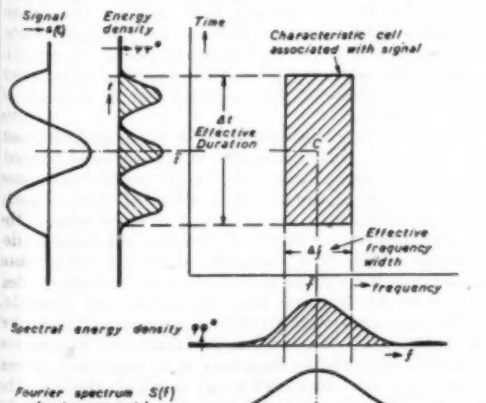


Fig. 1. CHARACTERISTIC RECTANGLE OF A SIGNAL IN THE INFORMATION DIAGRAM

Consider a given signal described as $s(t)$ in 'time language' and by its Fourier transform $S(f)$ in 'frequency language'. If $s(f)$ is real, $S(f)$ will be in general complex, and the spectrum will extend over both positive and negative frequencies. This creates an unwelcome asymmetry between the two representations, which can be eliminated by operating with a complex signal $\psi(t) = s(t) + i\sigma(t)$, where $\sigma(t)$ is the Hilbert transform of $s(t)$, instead of with the real signal $s(t)$. This choice makes the Fourier transform $\varphi(f)$ of $\psi(t)$ zero for all negative frequencies. Next we define the 'energy density' of the signal as $\psi\psi^*$, where the asterisk denotes the conjugate complex value, and similarly $\varphi\varphi^*$ as the spectral energy density. In Fig. 1 the two energy distributions are shown as shaded areas. The two are of equal size; that is, the total energy of the signal is the same by both definitions. We can now define a 'mean epoch' $\bar{t}$ of the signal, and similarly a 'mean frequency' $\bar{f}$, as the co-ordinates of the centres of gravity of the two distributions. This gives a point C in the information diagram as the centre of the signal. Going a step further, we define the 'effective duration' Δt and the 'effective frequency width' Δf of the signal by means of the mean square deviations of the two energy distributions from the mean values $\bar{t}$ and $\bar{f}$. In the figure these appear as the inertial radii of the two shaded areas. For reasons which will become evident later, it is convenient to define Δt and Δf as $2\sqrt{\pi}$ times the respective inertial radii†. With these definitions a mathematical relation, the Schwarz inequality, can be applied, which states that

$$\Delta t\, \Delta f \geqslant 1; \qquad . \quad . \quad . \quad (1)$$

that is to say, *the area of the characteristic rectangle or cell of a signal is at least unity*. This is the exact formulation of the uncertainty relation between time and frequency. It is clear now that what we have obtained is a classical model of one-dimensional static wave mechanics, in which unity replaces Planck's constant h. Formally this 'quantum' is represented by a cell of unit (dimensionless) area in the information diagram. Its physical significance becomes evident from the following consideration.

If in a time interval T a signal is expanded in a Fourier series, there will be T complex Fourier components per unit frequency band-width. Thus we can say that the information diagram contains one complex datum per unit area. (This, of course, is to be considered as an asymptotic theorem for large areas, as by equation (1) we cannot analyse the information area into cells of less than unit order.) We see now that the quanta in this model of wave mechanics are *quanta of information*. Each quantum represents one complex numerical datum or two real data.

This result, in combination with the uncertainty relation (1), suggests the question whether there are signals for which the inequality turns into an equality, and which could be used for the representation of quanta. It can be shown that such simplest or 'elementary' signals exist, and their form is

$$s(t) = \exp - \alpha^2(t - t_0)^2 \,.\, \exp i2\pi f_0 t, \qquad (2)$$

† In the original paper the factor was $\sqrt{4\pi}$ instead of $2\sqrt{\pi}$, so that ½ appears in equation 1 instead of unity. The present choice is more advantageous for a direct comparison with quantum theory.

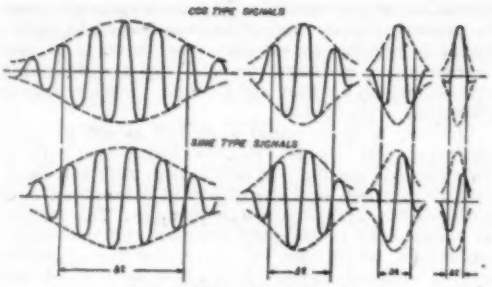


Fig. 2. ELEMENTARY SIGNALS

where α is a real constant. Thus the elementary signals are harmonic oscillations of any frequency f_0, modulated by a probability pulse. Their Fourier transforms are of the same mathematical form

$$S(f) = \exp - (\pi/\alpha)^2 (f - f_0)^2 \cdot \exp i2\pi t_0 f. \qquad (3)$$

The real components of the elementary signals are conveniently specified as cosine-type and sine-type signals, and are illustrated in Fig. 2 for several values of the constant α, which is connected with the effective duration and effective band-width by the equations $\Delta t = \sqrt{\pi}/\alpha$ and $\Delta f = \alpha/\sqrt{\pi}$. If $\alpha = 0$, the elementary signals become simple harmonic oscillations; if $\alpha = \infty$, they turn into the delta function and its derivative.

These elementary signals can be used for the representation of quanta of information, as any arbitrary signal can be expanded in terms of them, with any choice of the constant α. That is to say, we can expand a signal by dividing up the information area into unit rectangular cells of any aspect $\Delta t/\Delta f = \pi/\alpha^2$, and by associating with every cell an elementary signal with a complex amplitude factor c_{ik}. We thus obtain a sort of matrix, as illustrated in Fig. 3. This method of analysis contains 'time language' and 'frequency language' as special extreme cases. If the cells are infinite in the time direction we obtain Fourier analysis; if they are infinite in the frequency direction we obtain an expansion into delta functions, that is to say, the function $s(t)$ itself.

Expansion into elementary functions is in general a rather inconvenient mathematical process, as they do not form an orthogonal set. There exists, however, an experimental method, which, though not equivalent, gives somewhat similar and very valuable results. This is the method of 'sound spectrography'

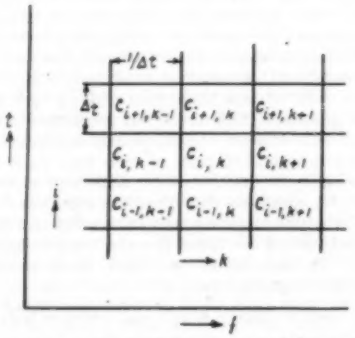


Fig. 3. MATRIX OF ELEMENTARY SIGNALS REPRESENTING AN ARBITRARY SIGNAL

developed by the Bell Telephone Laboratories during the War, and published after the original paper by the author was written and accepted[3]. There is no space here to describe this method and the difference between 'sound portraits' and matrices of elementary signals, but it may be noted that sound portraits are not complete representations of the original sound, though they contain most of its subjectively important features.

It is to be expected that the analysis of hearing sensations will prove a fruitful field for the new methods of representation, and the results so far obtained seem to indicate very clearly that the 'quantum of sound' is a concept of considerable physiological significance. Acoustical workers have collected a large amount of material on the threshold of ear discrimination for epoch and frequency differences. It appears that at least a good part of these results can be summed up in the statement that *the ear possesses a threshold area of discrimination of the order unity*.

One series of experiments which were analysed were those of Bürck, Kotowski and Lichte[4]. Their object was the threshold of time discrimination in different frequency-ranges. Mach showed that if a sinoidal oscillation is sounded for a few cycles only, the ear will hear it as a noise, while after a minimum duration of about 10 milliseconds it will be heard as a short musical note, with ascertainable frequency. The authors carried out a series of tests on this phenomenon, and in a second series went a step further. In these tests the intensity was doubled after a certain time from the start. If this was less than a certain minimum (21 msec. at 500 cycles), the sound could not be distinguished from a note which was sounded from the start with double intensity; beyond this the step could be heard as such. One could say that in the interval between 10 and 21 msec. the ear has just got ready to register a second, distinct sensation.

Another series of experiments is due to Shower and Biddulph[5] and relates to the threshold of differential frequency discrimination of the ear. Their technique was quite different. The frequency of a note was modulated between narrow limits, and the minimum frequency swing was noted which gave the impression of a 'trill'. At 500 cycles this minimum swing was 2·3 cycles. Below this the trill could not be distinguished from a pure note. The cycle of modulation was so chosen that it gave the finest frequency discrimination (0·5 sec. for the full cycle). In these experiments, as in those of Bürck, Kotowski and Lichte, intensity played no essential part, provided that the tests were carried out at a level of good audibility.

Though it might appear that in these experiments the frequency discrimination of the ear was tested, and in the previously mentioned experiments the time response of the ear, in reality, of course, both time and frequency are involved in both cases. In the experiments of Bürck, Kotowski and Lichte, the effective width of a sinoidal oscillation which has lasted only for a finite time has to be considered. In the tests by Shower and Biddulph the time of 0·25 sec. is necessary to notice one 'up' or 'down' of the frequency. Thus from the time and frequency intervals involved in each case it is possible to form a product, the 'threshold area', in which the ear was capable of registering one sensation only, and which must be exceeded if it is to register a second. The numerical value of this area is to some extent a

matter of definition. With the conventions adopted in the original paper, the threshold area calculated from the data of Bürck, Kotowski and Lichte was 1·05 at 500 cycles and 1·5 at 1,000 cycles, while the figures of Shower and Biddulph gave 1·17 in both cases. No such accuracy can of course be claimed, and the absolute values depend on the exact definition, but by any reasonable convention the threshold area is found to be of the order unity, that is to say, near the 'acoustical quantum limit'. It must be understood, of course, that there is an important difference between an acoustical quantum as registered by a physical measuring instrument, and as registered by the ear. In the experiments considered the ear was called upon only to answer 'yes' or 'no' to a simple question. To a measuring instrument, on the other hand, a quantum of information conveys a complex numerical datum (two real data), and every exact datum carries in itself an infinite number of 'yes's' and 'no's'. The difference is expressed by talking of 'discrimination' in the case of the ear and 'registering' in the case of a measuring instrument. In this sense we can say that, at least in simple experiments, the best ears in the optimum frequency-range can just about discriminate one acoustical quantum.

The importance of this result lies in the remarkably wide range of aspect ratios in which it seems to apply. As shown in Fig. 4 for the case of signals near 500 cycles, the threshold area does not vary appreciably while the time interval varies from about 20 to 250 msec.; that is to say, by more than a factor of ten. Within these wide limits the ear has the power of searching out by an automatic adjustment the finest details in the sound pattern offered to it. If a short sound strikes the ear, with poorly defined frequency, the time discrimination is of the order of 20 msec. If the sound is prolonged, so that its effective band-width shrinks to a few cycles per second only, the frequency discrimination of the ear keeps in step with this process for at least a quarter of a second. An old problem of physiological acoustics appears here in particularly sharp relief. No simple physical system of resonators could account for this degree of perfection. Resonators can be tuned to wide bands or to narrow ones, but not to both simultaneously. From physiological data, and in particular from the experiments of Wegel and Lane[6] on 'masking', it is practically certain that the ear resonators are very strongly damped, with decay times of the order of 10 msec. or less. They are tuned to bands approximately as wide as would account for the results of Bürck, Kotowski and Lichte, but not for those of Shower and Biddulph, which would require for their explanation decay times at least ten times longer. Thus the postulation of a second mechanism in the ear, which accounts for its apparent progressively refined tuning in the case of prolonged sounds, appears to be inescapable.

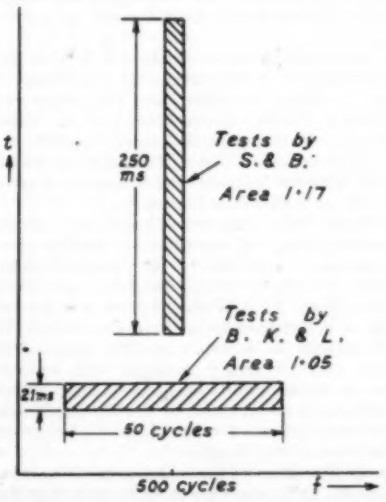


Fig. 4. THRESHOLD AREAS OF THE EAR AT 500 CYCLES/SEC.

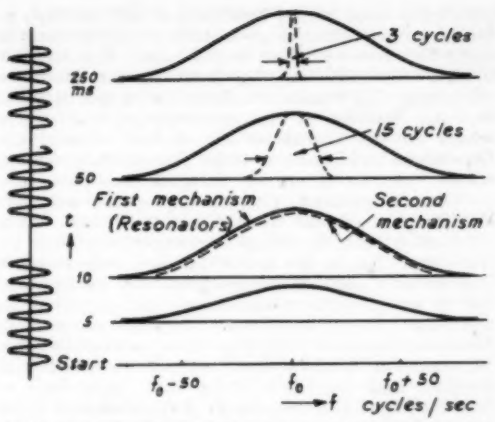


Fig. 5. THE TWO MECHANISMS OF HEARING. IF A NOTE IS SOUNDED FOR MORE THAN ABOUT 10 MSEC. THE RESONANCE PATTERN OF THE INNER EAR REMAINS UNCHANGED; BUT A SECOND MECHANISM STARTS SEARCHING FOR THE MAXIMUM OF EXCITATION AND LOCATES IT WITH AN ACCURACY WHICH INCREASES UP TO ABOUT 250 MSEC.

The role of the two 'mechanisms' is roughly illustrated in Fig. 5. The first is probably the real mechanism of the ear resonators; the second is almost certainly non-mechanical. One might be tempted to locate it in the brain, but this assumption is not unavoidable. It might well be a new phenomenon in nervous conduction, and could be explained by the hypothesis that conduction in adjacent nerve fibres is to some extent unstable, so that the more strongly excited fibre gradually suppresses the excitation of its less strongly excited neighbour. Thus if a pure note is sounded for a sufficient time, less and less fibres will be excited, until finally only the fibre corresponding to the position of maximum amplitude in the basilar membrane remains in action. This makes it possible to ascertain the frequency with far greater accuracy than one would expect from the broad tuning of the mechanical resonators. It would be most interesting, though probably very difficult, to prove or to disprove this effect, perhaps by a further refinement of the techniques of Galambos and Davis[7].

It is interesting to note that we begin to perceive a sound as 'musical' just at the point where the second mechanism takes over. Speech would be perfectly intelligible by the first mechanism alone; but the second is necessary to enable us to appreciate music.

Finally, it may be asked whether quantum theory has anything to learn from the acoustical model. In a formal sense the answer must be, of course, in the negative. From the fact, however, that two different fields

admit the same formal treatment it follows that, so far as the mathematics goes, there can be nothing in one which is not implicit in the other. But familiar models of less familiar phenomena have at least one advantage. They make it easier to distinguish between intrinsic features of the phenomenon, and others which are introduced by the method of analysis. One might be inclined to think that sharply defined states, characterized by integral numbers, are peculiar to quantum phenomena, or at least that they require special mechanisms to imitate them classically, such as strings or membranes. But we have seen that in the acoustical model the integers emerge as a part of the mathematical background before any physical phenomenon has appeared on the stage. The ultimate reason for the emergence of 'acoustical quanta' is that we have viewed the same phenomenon simultaneously from two different aspects, and described it by two 'quantities of interest', time and frequency. Any number of other classical models may be found, if only we ask simultaneously two kinds of questions about the same thing, or perform two lines of experiments on it, provided that the questions are neither identical nor independent.

[1] Landé, A., "Vorlesungen über Wellenmechanik" (Leipzig, 1930).
[2] Gabor, D., *J. Inst. Elect. Eng.*, Part III, **93**, 429 (1946).
[3] Potter, R. K., *Science* (Nov. 9, 1945). Koenig, W., Dunn, H. K., and Lacy, L. J., *J. Acoust. Soc. Amer.*, **18**, 19 (1946).
[4] Bürck, W., Kotowski, P., and Lichte, H., *Elek. Nachrtech.*, **12**, 326 (1935); **12**, 355 (1935).
[5] Shower, E. G., and Biddulph, R., *J. Acoust. Soc. Amer.*, **3**, 274 (1931).
[6] Wegel, R. L., and Lane, C. E., *Phys. Rev.*, **23**, 266 (1924).
[7] Galambos, R., and Davis, H., *J. Neurophysiol.*, **6**, 39 (1943); **7**, 285 (1944).

A CHEMICAL BICENTENARY AT THE UNIVERSITY OF GLASGOW

By Dr. ANDREW KENT

Department of Chemistry, University of Glasgow

ARISTOTELIAN physics and astronomy had had place in the arts curriculum at the College of Glasgow ever since King Jamie wi' the Fiery Face welcomed the advent of Scotland's second University (1451). In the eighteenth century a more modern science was recognized by the institution of chairs in natural philosophy (1717) and practical astronomy (1760).

Between these events in the Faculty of Arts, William Cullen completed the first course of lectures in chemistry (1747). This lectureship in the Faculty of Medicine was part of a renewed and finally successful effort to provide his *Alma Mater* with the prestige of a comprehensive medical school, the steady expansions of which included the later regius chair of chemistry (1818).

Cullen was perhaps the greatest physician to teach chemistry in this or any other British university. Although there is some evidence that he would have preferred to place the subject in the wider field of arts, there was, of course, nothing unusual in its association with eighteenth-century medicine. The notable factors are the broad and enlightened views which this polymathic personality adopted in the scope and emphasis of his teaching, and his lasting influence on the new department.

During 1747–1874 the Department was headed, for all but three years, by professional physicians. Although the degree of B.Sc. was first conferred in 1873, and the belated Faculty of Science (1893) included lectureships in organic chemistry (1898), in metallurgical chemistry (1899) and in "Physical Chemistry including Radio-activity" (1904), the chair of chemistry was first detailed in the calendar under 'Faculty of Science' only in 1920. Although even the nineteenth-century class of 'Practical Chemistry' pursued a course of "bases and acids, poisons and the pharmaceutical compounds", there was always a group of 'laymen' in the principal class of systematic chemistry and in the laboratory. For these freedoms of outlook and emphasis a lasting gratitude is due to William Cullen.

So the portentous association of Joseph Black (1756) with James Watt has its place in world history. John Robison (1766) was not a physician. William Irvine (1769) and T. C. Hope (1787) were physicists of note. Robert Cleghorn (1791) may have concentrated unduly on his duties to the students of medicine; but with Thomas Thomson (1817), the first regius professor, the lectures certainly reverted to a wider scope, which was undiminished during the tenure of his successor, Thomas Anderson (1852). With the advent of John Ferguson (1874) the medical dynasty is at an end: the now legendary 'Soda' took an active part in framing the new Faculty of Science, and in completing a near century of service by the first three regius professors. The fourth, G. G. Henderson (1919), guided the Department to its present Faculty. The 'auld alliance' has since been represented by a lecturer in 'Chemistry for students of Medicine' and by the research interests of George Barger (1937) and of James W. Cook (1939). In the Gardiner chair T. S. Patterson (1919) and J. Monteath Robertson (1942) have emphasized the modern significance of organic and of physical chemistry.

These heads of department, six of whom were products of the chemistry class, have seen their opportunities grow fiftyfold since some twenty students first gathered around Cullen. Since 1861 they have enjoyed the support of official colleagues such as, among others, William Ramsay, J. J. Dobbie, Frederick Soddy and C. H. Desch. The present teaching and research staff, some thirty strong, installed in a new and well-equipped building, have also behind them two hundred years of provocative tradition.

The Department has not only carried out its natal responsibilities in the teaching of medicine. It has helped to fashion in earlier days physician-scientists like Joseph Black, John MacLean of Princeton, and Thomas Graham, professional scientific workers like John Robison, William Thomson (Lord Kelvin) and (Sir) William Ramsay, *entrepreneurs* like Charles Macintosh and William Couper.

The Duke of Hamilton, descendant of Cullen's friend and patron, will preside over the first of a bicentenary series of lectures to be given this month by Dr. Douglas Guthrie, Prof. John Read, Dr. Alexander Fleck and Prof. A. R. Todd. Later, it is intended to publish a commemorative volume, edited by the present writer, in which scientific men of diverse interests and of many colleges will combine in tribute to those early pioneers whose far-sighted ambitions have eventuated in the multifold activities and the wide influence of the school of chemistry at the University of Glasgow.

The careless dust of time has overlaid some points of interest. It is not easy now to discover the type of chemistry taught by Cleghorn during a tenure of

the lectureship (1791–1817) which included many exciting advances in the subject; an era much given to portraiture and cartoon has left no traceable reproduction of the lineaments of William Irvine; memorialists have often concentrated on the various medical chairs which were held concurrently or successively by the lecturers in chemistry. Enough remains to afford a reasonable pride in associations with hermetic antiquity.

Lavoisier and Dalton were to find paladins in Hope and Thomas Thomson, but Boerhaave and Stahl were the first pedagogic exemplars. If alchemy were never countenanced, the 'Four Elements' and the *Tria Prima* were topics of critical discussion in the earliest lectures. From that point onwards the making of modern chemistry is mirrored in the teaching and researches of its exponents at Glasgow, and in the later activities of those thousands whose names have been enrolled in the class of chemistry since 1747.

TAXONOMY OF AQUATIC INSECT NYMPHS AND LARVÆ

By Dr. T. T. MACAN

Laboratory of the Freshwater Biological Association, Wray Castle, Ambleside, Westmorland

ALMOST any collection of freshwater animals will contain a high proportion of insects in the larval or nymphal stage, and a number of these cannot, at present, be named with certainty. The work of many biologists, whether their interest be in ecology, physiology or the food of fish, is affected by this gap in our knowledge, and the importance of closing it need not be stressed. It is the belief of the Freshwater Biological Association that, with sufficient co-operation from workers in other parts of the country, it should be possible, within a few years, to produce keys for the identification of the aquatic stages of all the important groups, except the Diptera. The purpose of this article is to appeal for this co-operation, to which end it includes brief notes on the existing systematic literature of the various groups and a short account of some of the methods of rearing adults from their nymphs or larvæ.

It is hoped that some workers in other laboratories may be induced to turn their attention to systematic studies, and the Freshwater Biological Association is prepared to give all the assistance it can. Others may be able to help by breeding out the species occurring in their own neighbourhood and sending the material to Wray Castle to be described.

The Ephemeroptera and Odonata are under investigation at the moment at Wray Castle. The most urgent need is the description of those species at present not described in any language; but it is also desirable to redescribe and figure some of the species already known, as almost all the existing literature is based on Continental material and the illustrations do not conform to a uniformly high standard.

The Coleoptera and Hemiptera, which are aquatic throughout life, are considered of less importance at the present moment. The position of the other main orders with aquatic nymphs or larvæ is as follows:

Plecoptera. Hynes[1] has described twenty-six out of the thirty-four probable British species, and two have been described since.

Ephemeroptera. Schoenemund's[2] key to the German species includes thirty of the forty-seven British species. Descriptions of some of the remaining seventeen are scattered through the literature. The biggest gap is the genus *Baëtis*, common and widespread in Britain and an important element in almost any stream or river. There are nine British species, but the nymphs of only three have been described, and one of these is probably associated with the wrong adult.

Odonata. Lucas[3] gives a key to the nymphs of all the British species, but experience at Wray Castle suggests that some of the species are distinguished on insufficient material, and the key does not always give the right answer. May[4] states that sufficient information to make a key to the subfamily Agrioninæ or the genus *Sympetrum* is not available. The group clearly requires further study.

Trichoptera. The most complete key, that given by Rousseau[5], is somewhat out of date. A revision of the larvæ of the group is being undertaken by Dr. N. E. Hickin, who has so far described some twenty of the British species (see Hickin[6] for list of references).

Diptera. Complete keys to some of the smaller families, for example, Culicidæ[7] and Simuliidæ[8] exist; others are among the least known of all the aquatic animals. The outstanding gap is the Chironomidæ, a very large family and one of great importance in freshwater biology. In spite of detailed work in Germany most larvæ can only be separated into species groups. Reference may be made to Goetghebuer and Lenz[9]. Separation into groups can also be effected by the use of Johannsen's[10] keys, although this author is primarily concerned with the American fauna.

Many Ephemeroptera and Plecoptera live in flowing water which is always cool and well oxygenated. Hynes[1] describes a technique for rearing the nymphs which are collected in such places, and the apparatus is figured by Worthington[11]. Series of flat enamel dishes are placed on sloping shelves one below the other. Water entering the top dish of each series from a tap drips from one dish to another. Each dish is provided with stones for the nymphs to cling to and is covered with a sheet of mosquito netting on a wire frame. It is necessary to transfer newly emerged Ephemeroptera to a small tube for a day or two, in order to allow the imago to emerge from the sub-imago. Both nymphal skins and adults should be preserved in 2½ per cent formalin, the adults being first wetted in 70 per cent alcohol.

Stream-dwelling Ephemeroptera have, however, been reared in stagnant conditions where a supply of river water was immediately available. Useful collections have also been made by catching emerging sub-imagines in the field. A large collection of nymphs is made; those which, from their silvery appearance, are evidently about to emerge, are sorted into a dish, the collection is then watched, and each sub-imago is caught as it emerges.

Most Odonata inhabit stagnant waters and are easier to rear. They may be kept in pie dishes without running water, one nymph to a dish or they will devour one another. A stick or piece of reed should be provided for the nymph to crawl up before emergence. Each dish should be covered by a cage, though, if this is not possible, and the dishes are in a room, of which the doors and windows can be kept closed, it is seldom that an adult is lost or cannot be associated with the skin from which it came. The

adult should be caged for several days after emergence, so that the colours may develop. The brilliance of wild specimens is never attained by captives, but the colours develop sufficiently for systematic purposes. Adults and nymphal skins should be preserved in 70 per cent alcohol and kept in the dark.

The cast skins of exopterygote insects are sufficient for taxonomic purposes, but it is always desirable to have some preserved nymphs from the same locality.

Detailed descriptions of rearing techniques are given by Galtsoff *et al.*[12].

[1] Hynes, H. B. N., *Trans. Roy. Ent. Soc. Lond.*, **91**, 459 (1941).
[2] Schoenemund, E., "Eintagsfliegen oder Ephemeropteren". In Dahl, F., "Die Tierwelt Deutschlands und der angrenzenden Meeresteile". Teil 19. (Jena: Fischer, 1930.)
[3] Lucas, W. J., Ray Society No. 117 (London, 1930).
[4] May, E., "Libellen oder Wasserjungfern (Odonata)". In Dahl, F., "Die Tierwelt Deutschlands und der angrenzenden Meeresteile". Teil 27. (Jena: Fischer, 1933.)
[5] Rousseau, E., "Les larves et nymphes aquatiques des insectes d'Europe". (Brussels: Lebègue et Cie., 1921.)
[6] Hickin, N. E., *Trans. Roy. Ent. Soc. Lond.*, **97**, 187 (1946).
[7] Marshall, J. F., "The British Mosquitoes". (London: British Museum (Natural History), 1938.)
[8] Smart, J., "The British Simulidæ with Keys to the Species in the Adult, Pupal and Larval Stages", Freshw. Biol. Ass. Brit. Emp. Sci. Pub. No. 9, 1–57 (1944).
[9] Goetghebuer, M., and Lenz, F., in Lindner, E., "Die Fliegen der palæarktischen Region". (Stuttgart: Schweizerbart'sche V.B.H. 1933 *et seq.*)
[10] Johannsen, O. A., "Aquatic Diptera", Parts 1–5. Mem. Cornell Univ. Agric. Expt. Station (Ithaca, N.Y., 1933–37).
[11] Worthington, E. B., "Breeding Aquatic Insects", *Salmon and Trout Mag.*, 1–4 (Sept. 1939).
[12] Galtsoff, P. S., Lutz, F. E., Welch, P. S., and Needham, J. G., "Culture Methods for Invertebrate Animals". (Ithaca, New York: Comstock Publ. Co., 1937.)

OBITUARIES

Prof. B. A. McSwiney, F.R.S.

In the sudden and most untimely death of B. A. McSwiney on March 8, physiology and physiologists have suffered a most grievous loss. At a time when enthusiasm, energy and wisdom are conjointly needed for the development of medical education and its safe progress in a period of transition, the University of London and the Medical School of St. Thomas's Hospital have lost a professor and a dean who possessed these qualities in abundance.

McSwiney's scientific career, apart from the war years, was largely orthodox. After a year as lecturer in Leeds, he became lecturer in experimental physiology in the University of Manchester and had the good fortune to work in that laboratory when, under the stimulus of A. V. Hill, it was awakening from a long sleep. His early publications reveal an interest in the development of apparatus for teaching and research which he never lost; but it was not until 1923 that he started working on two quite different subjects which eventually were to shape all his subsequent activity. With Crichton Bramwell and A. V. Hill he published a paper on the velocity of the pulse-wave in man, and a year later, with the late E. D. McCrea, J. W. Morison and J. S. B. Stopford, one on their work on the normal movements of the stomach.

The innervation of the stomach remained McSwiney's chosen interest, and into the morass of conflicting statements, bad experiments and misleading results which confuse the literature he plunged with unabated energy. His work has revealed many of the sources of error which have beset previous workers and has formed a firm scaffold of sound experiment within which others may build. It is of interest to follow the directions in which the problem of gastric innervation led him. He followed at one time the attractive by-path of the physiology of isolated smooth muscle; he developed an elegant nerve–smooth muscle preparation which permitted an approach to be made to the analysis of the peripheral interaction of vagal nerve volleys; and, at the other end of the scale, he and W. R. Spurrell developed a method of outlining the stomach so that its activity could be observed radiographically, without the disturbance and abnormality of an opaque meal.

But this was to take place some years hence. In the meantime, at Manchester, the University had decided to start an honours school of physiology, and it was in the intimate teaching of the chosen few that McSwiney reached his peak. He was obviously too good to last long as a lecturer, and in 1926 he was appointed to the chair of physiology in Leeds.

Here was a splendid opportunity; a relatively small department was ripe for development, and there was the prospect of the extension of the medical school at an early date. McSwiney set to with gusto to build a Physiology Department second to none in the provinces. The old building was reconstructed internally, and, in a few years time, a new building rose which bore the unmistakable stamp of the foresight, skill and energy of the prime mover in its completion. Yet in spite of this interest in bricks and mortar, he was building within his laboratory a research team of great potential. He paid the inevitable penalty of losing men as he made them, but it must have been a source of pride to him to know that eight of his staff at Leeds eventually went to chairs, or posts of equivalent rank. He paid again in the energy he expended, willingly and happily; but the result was a peculiarly happy and friendly laboratory.

It was towards the end of his stay in Leeds that McSwiney published a paper on the afferent fibres from the abdominal viscera. This was the first of a long series with a number of different collaborators, and in it McSwiney had obviously found the subject of his heart. The technique employed was apparently simple, suggesting that little more was needed than observation of the pupil and excitation of nerves by the homely pinch or an induction shock. It demanded, however, the exercise of the experimenter's full artistry to maintain the integrity of labile reflexes in animals exposed to extensive surgical interference, and a most rigid exclusion of a multitude of complicating factors. McSwiney and his colleagues were building a fine structure of knowledge on visceral afferent pathways, much of it with direct application to human medicine. It is to be hoped that his death has not brought the work to an end.

McSwiney left Leeds in 1936 to succeed the late John Mellanby as professor in the Sherrington School of Physiology, St. Thomas's Hospital, and here he set out to continue the work so successfully started in Leeds; but not for long, as he was soon involved in the turmoil of war and evacuation of the Medical School to Godalming. Ordinary research work came to a standstill, and his laboratory undertook practical problems of wound shock and oxygen therapy. With the return of peace his unflagging energies were devoted to the return of his medical school to its normal activities and to the repair of the spiritual and physical damages of war.

No comments on McSwiney's career would be complete without reference to the service which he

gave to the Physiological Society. He became a member in 1920 and served on its committee during 1928–34. He was then elected treasurer of the Society, and fulfilled this onerous and responsible task for ten years, at a time when the rapid development of the Society demanded a wise and careful control of its finances. He was in this, as in so many of his activities, supremely competent and effective. His election to the Royal Society in 1944 held out the prospect of widening further the scope of the services he might give to science, great as they had already been.

In the memory of many, McSwiney will remain as an administrator and organiser; but good as he was at these tasks and great as was his flair for the strategy and tactics of the committee, his real place was as an inspiration and guide to his younger colleagues. He himself would never have claimed to be a great investigator, but those of us who had the privilege of working with him know that he had that peculiar quality of leadership which brought out the best in his collaborators in a happy spirit of comradeship.

G. L. Brown

Prof. Gregori Aminoff

Gregori Aminoff, head of the Mineralogical Department of the Museum of Natural History (Riksmuseum), Stockholm, died on February 11, 1947. His death was caused by heart disease, which had during the last few years of his life greatly reduced his capacity for work.

Aminoff, who was born in 1883, belonged to an old Russian Boyar family, a member of which became a Swedish subject in the year 1612. He studied science in Stockholm and obtained his first academic degree in Uppsala in 1905. A strong artistic inclination caused him then to change his profession, and for several years he practised as an artist and studied art in France and Italy. About 1913 his old interest in science became predominant, with the result that he returned to studies in mineralogy. Aminoff's thesis for his doctorate, a crystallographic treatise on calcite and barytes from Långbanshyttan, appeared in 1918, and in the same year he was appointed lecturer in mineralogy and crystallography in the University of Stockholm.

In 1918 the Mineralogical Institute of the University of Stockholm acquired equipment for the X-ray investigations of crystals, and Aminoff was the first to use this apparatus, thus introducing X-ray methods into Sweden. At first he studied several simple structures, and among them found the first representatives for the *C* 6 (brucite and pyrochroite) and *B* 8 (nickel arsenide) types. His very extensive studies over a period of several decades of the minerals from Långban also included much X-ray work.

In 1923 Aminoff was appointed a professor and head of the Mineralogical Department of the Museum of Natural History in Stockholm. After he had obtained adequate laboratory equipment in the Museum, he could take up his research work in the new surroundings. The Långban minerals occupied much of his time, but he also devoted himself to general problems, for example, the mechanism of evaporation and dissolution of crystals. His theoretical study of the contact zone between the two individuals of a twinned crystal is of great value. Aminoff also made use of electron diffraction, as, for example, in his study of the oxidation of zinc sulphide crystals. In this case the known properties of the oxide and sulphide lattices explained the observed relative orientations of the two lattices, but could not explain the non-appearance of some orientations. In the studies last mentioned, as in much other work, Aminoff was assisted by his wife, Birgit Broomé-Aminoff.

In later years Aminoff was very interested in geochemical problems and made use of X-ray spectroscopy for his analytical work. He also spent much time trying to improve the technique of this method. Some of his latest papers (see, for example, *Nature*, April 20, 1946, p. 517) contained descriptions of his efforts to obtain large dispersion by using ground instead of natural crystal faces.

Aminoff was a born investigator who carried on his research for the sake of science. He was a very modest man of retiring disposition. This, together with the non-educational character of his institution, isolated him rather from the wider circles of Swedish science. But he never felt happier than when a friend dropped in at his laboratory with whom he could discuss his research problems.

G. Higg

Prof. Fred Vlès

Fred Vlès, zoologist and biophysicist, professor in the Faculty of Medicine at Strasbourg, died on July 2, 1944, at the age of fifty-nine; he was one of a convoy of 2,500 political prisoners, taken by train from Compiègne to Dachau, of whom only 1,500 arrived alive. He had been arrested by the Gestapo at Clermont-Ferrand, where the University of Strasbourg had been evacuated. When warned that the German police were looking for him, he refused to hide for fear of possible reprisals on his colleagues.

Vlès had been a pupil of Yves Delage and was *préparateur* at the Roscoff Marine Biological Station during 1905–14. During the First World War he served in the Zouaves and was twice mentioned in dispatches. His only son, Claude, was killed in the Second World War, in the French aviation service. Vlès was a biologist with wide and original interests. He started as a zoologist, became more and more attracted to the physical chemistry of the cell, and eventually applied his knowledge to problems of human pathology. In 1921 he founded the *Archives de Physique Biologique*, and edited this journal until his death. He was one of the first to make use of cinematography in microscopy, in an investigation of the cleavage of the sea urchin egg in 1911.

Many of Vlès' researches were in the field of spectroscopy, and through this I came to know him and appreciate his human and scientific qualities when working in his laboratory at Strasbourg on the spectroscopy of chlorocruorin. Vlès was very much *le maître* to his pupils, who had an immense admiration and affection for him. He made for himself a special place in French biology which will be difficult to fill.

H. Munro Fox

We regret to announce the following deaths:

Dr. I. Seymour A. Hadwen, formerly director of pathology and bacteriology at the Ontario Research Foundation, known for his work on animal pathology.

Prof. H. S. Jennings, emeritus professor of zoology in Johns Hopkins University.

Dr. S. A. Monckton Copeman, F.R.S., an authority on vaccination, on April 11, aged eighty-five.

NEWS and VIEWS

Dr. Robert Broom, F.R.S.

THE election of Dr. Robert Broom as an honorary fellow of the Royal Society of South Africa is a recognition of a long life devoted to scientific work. As a student of medicine in Glasgow, Dr. Broom became fascinated by the problem of the ancestry of mammals, and on qualification migrated to New South Wales in order to work on the comparative anatomy and embryology of monotremes and marsupials while earning his living as a general practitioner. The Australian scientific world discovered his existence when a paper on the Organ of Jacobson arrived at the Linnean Society from an unknown man in the bush, to be followed by others. But during a visit to England, Broom saw some of the fossil reptiles recently brought from South Africa by Prof. H. G. Seeley, and realizing immediately that they presented a novel and direct approach to his problem of mammalian ancestry, sailed for South Africa instead of returning to Australia. There in a very few years he revolutionized our knowledge of the fossil reptiles of the Karroo, showed in broad outline how they were related to one another, and introduced a zonal subdivision of the rocks in which they were found which has proved to be applicable in Russia and China as in Central Africa. In 1910 Broom visited New York and there discovered that the Pelycosaurs from the Texan Permian were closely related to the Deinocephalia, the most primitive group of the African mammal-like reptiles. His paper on this subject established this point once for all, and has ever since formed a point of departure from which all more recent work on the classification and evolution of reptiles has proceeded.

This early work of Broom's is remarkable because in it he used his fossils for the solution of specific problems of morphology, and thus introduced a new point of view into vertebrate palæontology. But while actively working on Karroo fossils and for the greater part of his life remaining in medical practice, Broom found time to investigate the poor fragments of fossil mammals found in Pleistocene deposits in South Africa, describing many of them and showing that an extinct Quaternary fauna had existed in that land. When Prof. R. A. Dart discovered the skull of *Australopithecus*, Broom began an examination of the numerous 'bone caves' which exist in South Africa and soon found two new genera of allied giant apes. His view on the significance of these forms is fully set out in a recently published monograph (see *Nature*, June 29, 1946, p. 863), in which he shows that the three form a special sub-family of giant apes, differing in very many ways from those which still live, and that in all these ways they resemble man. They are, in fact, the most man-like in structure of all the primates; and there is some indication that, unlike the forest-dwelling gorillas and orangs, they lived in a dry country not unlike South Africa to-day. The latest discovery is described by Dr. Broom on p. 602 of this issue. This work is the most important contribution to the problem of human ancestry published for many years, and is a fitting climax to Dr. Broom's fifty years work.

Boyle Medal of the Royal Dublin Society: Prof. J. H. J. Poole

THE Council of the Royal Dublin Society, on the recommendation of its Committee of Science, has awarded the Society's Boyle Medal to Prof. J. H. J. Poole, professor of geophysics in the University of Dublin, for his distinguished contributions to geophysics, many of which have been published in the Society's *Proceedings*. His early work, much of it in conjunction with the late Prof. J. Joly, was largely concerned with the measurement of the radioactivity of the earth's crust. His more recent papers include discussions of the earth's thermal history, the evolution of the atmosphere, and the possibility of initiating thermo-nuclear reactions under terrestrial conditions.

Building Research Division, National Research Council, Canada

PROF. R. F. LEGGET, associate professor of civil engineering, municipal and structural division, University of Toronto, has been appointed head of the Division of Building Research under the National Research Council, Canada. The new Division of Building Research will work very closely with the Central Mortgage and Housing Corporation, and will provide the required scientific data for an adequate programme in all fields of construction, including building materials, types of construction, lay-out, and all other essential features. Prof. Legget had extensive experience in construction engineering in Great Britain and on the Continent before going to Canada in 1929 to join the Construction Division of the Power Corporation of Canada. He later became a member of the staff of the University of Toronto. Born in Liverpool in 1904, he was trained at the University of Liverpool.

Marconi Jubilee and Exhibition

FIFTY years ago, in 1897, Signor Guglielmo Marconi gave the first demonstration of wireless telegraphy which was recognized by the Postmaster-General as establishing a new means of communication. At that time, Marconi was twenty-three years old, and he had come to Great Britain in the previous year from Bologna, where he had conceived the idea of using the so-called Hertzian waves for the development of a means of signalling without a wire connexion between the sending and receiving stations. Sir William Preece, who was the engineer-in-chief of the Post Office at the time, had been conducting experiments with a wireless circuit using magnetic induction between large loops; and it was due to Preece's interest and encouragement that Marconi was able to develop his experiments, leading to a successful demonstration across the Bristol Channel. It was in commemoration of this demonstration that a jubilee dinner was held at Guildhall on April 21 under the presidency of Lord Listowel, the retiring Postmaster-General.

In further celebration of these achievements of fifty years ago, the Marconi Company arranged a Jubilee Exhibition at Queen's House, Kingsway, London, during April 23–May 2. The Company was originally formed as the Wireless Telegraph and Signal Company soon after the demonstration mentioned above. A few years later, this became Marconi's Wireless Telegraph Co., Ltd., and, with the associated Marconi International Marine Communication Co., Ltd., has recently been incorporated in the English Electric Group of Companies. The exhibition comprised a photographic and pictorial display together with a collection of apparatus and equipment developed for various applications; this collection

ranged from a replica of Marconi's original transmitter as used in 1897 to the marine type of rotating radar aerial with P.P.I. display which is being fitted to merchant ships to-day. Special attention was also given to the modern applications of radio waves, including high-speed communication and printing equipment, direction-finding apparatus, and mobile telegraph and telephone equipment for police and other purposes. In view of the present widespread use of radio waves for communication, broadcasting, television, navigational aids, surgical and industrial purposes, it is interesting to have this reminder that the whole of the technique in these fields has been developed during the past fifty years.

Amalgamation of the Institutions of Mechanical Engineers and Automobile Engineers

An important and heartening announcement is that of the amalgamation of the Institution of Mechanical Engineers and of the Institution of Automobile Engineers, which took place on April 13. During the past fifty years and more, the individual energies of engineers have been dissipated and their corporate authority has been lessened by the multiplicity of engineering institutions which grew up to satisfy the needs of specialist branches of the profession. Though many of these younger institutions have done excellent work in furthering the development of particular sections of engineering, which it was felt at the time of their foundation were neglected by the senior institutions, there is no doubt that the engineering profession has been split by conflicting allegiances, and that it has been more difficult for engineers to speak with one voice on important issues. The Institution of Mechanical Engineers was founded in 1847, so that the amalgamation occurs most happily in the year that the Institution celebrates its centenary. The Institution of Automobile Engineers is forty-one years old.

Under the terms of the agreement to amalgamate, the Institution of Automobile Engineers will surrender its charter and dissolve the Institution. Its corporate members will become corporate members of the Institution of Mechanical Engineers, being placed as the first members on the register of a newly formed Automobile Division. Whatever the advantages of the welding together of the combined membership—and they are great—it has clearly been made possible only by the generous and broad view taken, in the first place, by those holding office in the Institutions. The amalgamation augurs well for the future of mechanical engineering, and it is to be hoped that other institutions will not be slow to follow the example.

Jubilee of the Electron

April 30 marked the fiftieth anniversary of the announcement by J. J. Thomson, at an evening discourse at the Royal Institution, of the existence of the electron, and the first approximate estimate of its mass. Cathode rays had been extensively studied in many laboratories for the previous fifteen or twenty years, and their peculiar properties had been widely discussed. It was Thomson's genius which enabled him to unravel the confusing and almost contradictory clues which the experiments afforded as to the nature of the phenomenon, to grasp what was important and what was secondary in the evidence, and to make the final experiment which demonstrated beyond all reasonable doubt that the cathode rays consisted of negatively charged particles, all alike, and all much smaller than the smallest particle hitherto known to science, the atom of hydrogen. The Institute of Physics and the Physical Society, in collaboration with the Institution of Electrical Engineers, is arranging to mark this jubilee by a series of lectures and other functions in London on September 25–26 next; an exhibition demonstrating the great influence this discovery in pure physics has had on the life of the community will be opened at the Science Museum, London, on September 26 and will remain open for about three months.

Heredity

The importance of an international forum of publication in science is not likely to be underestimated by readers of *Nature*. In many branches of science the responsibility was undertaken before the War by journals published in Germany and, to a less extent, in Italy and Japan. Their sudden removal by war was not so seriously felt at the time, owing to the temporary reduction of fundamental research, but it has now raised a serious problem. The position of genetics in this regard is a special one. This science is not only rapidly advancing but it is also rapidly broadening its scope. Indeed it is beginning to cover every aspect of biology and every form of life. It is beginning to weave the threads of many different sciences and techniques into a single pattern. Darwinism and biometry, Mendelism and cytology are being joined together, and the needs of medicine and agriculture are being met by the establishment of a single fundamental discipline. But the work that is necessary to accomplish this task is scattered over the whole world and is developing different characters in different countries.

In these circumstances an explicitly international journal of genetics is bound to serve a useful purpose. Dr. C. D. Darlington and Prof. R. A. Fisher are founding such a journal in collaboration with a group of distinguished foreign geneticists. It will be known as *Heredity* and will be published by Messrs. Oliver and Boyd. The articles promised for the first volume (of which Part 1 is now due to appear) include contributions from a dozen different countries. They cover, if not the whole range of genetics, at least a large part of it. Of outstanding interest perhaps is a bibliography of genetics articles published in Germany and Italy during the War and a summary of British work for the same period. The development of this journal will be watched with keen interest throughout the scientific world.

Whitworth Scholarship Regulations

New regulations for the Whitworth Scholarships which the Minister of Education will offer for competition in 1948 have been published (H.M. Stationery Office. 3*d*. net). The following awards will be available: two Whitworth Senior Scholarships, tenable for two years, valued at £325 each; five Whitworth Scholarships, tenable for three years, minimum value £200 each; ten prizes valued at £20 each, to unsuccessful competitors for Whitworth scholarships whose work deserves recognition, the money to be spent in the furtherance of the competitor's engineering education. The conditions governing the Whitworth Scholarships have now been altered in two main respects. Candidates must have completed twenty-four months of works training instead

of thirty months as hitherto, and entry is still limited to part-time students. The Ministry of Education Science Scholarships examinations in engineering will continue to be used for the purpose of making the awards, but the conditions for these have also been amended. Candidates will be required to reach a certain minimum standard in the two qualifying papers of mathematics and applied mechanics, and will also be required to take three scholarship papers, chosen from a number of alternatives. Workshop technology is introduced for the first time as one of these subjects. The entries for the Whitworth Senior Scholarships have, in the past, been governed by the same conditions as for the Whitworth Scholarships. Many university students could not qualify, however, because of the practical training conditions; this requirement has now been omitted, but a successful candidate will have to spend at least one year in a works on taking up a Senior Scholarship. No formal examination will be held, but a candidate must submit a thesis on one of a number of specified subjects.

Collection of Czechoslovak Chemical Communications

FOUNDED in 1929 for the purpose of publishing in French or English the results of researches conducted by Czechoslovak chemists, the *Collection of Czechoslovak Chemical Communications*, which ceased publication in 1939, has now been resumed under the same editorial direction of Profs. J. Heyrovský and E. Votoček. The first issue for 1947 contains an appreciation of the scientific work of Prof. Antonín Šimek, who was executed by the Germans during the War (see *Nature*, 152, 69; 1943). About half this issue is taken up with the recent polarographic researches of Heyrovský and his co-workers, who have studied certain phenomena at the dropping (and streaming) mercury cathode both polarographically and oscillographically. These open up an important new field in the study of electrode interfaces. From the laboratory of Prof. Votoček there is a paper on the synthesis of the remaining monomethyl-azulene. The authors, F. Šorm and J. Fajkoš, started with *cis*- and *trans*-cyclopentane-dipropionic-(1, 2)-acids, and by a series of interesting steps arrived at the trinitrobenzene compound of 6-methyl-azulene. This was decomposed chromatographically over an aluminium hydroxide column. Finally, methyl-azulene was crystallized as a purple-blue solid, m.p. 83° C. Another contribution to organic chemistry is by Dr. R. Lukeš, who describes N-methyl-1.2.5.6.-tetrahydropyridine. The subscription for the journal has been raised to £2 or 400 Czechoslovak crowns.

Royal Institute of Chemistry: Anniversary Meeting

THE sixty-ninth annual general meeting of the Royal Institute of Chemistry was held on April 18. In presenting the report of the Council for 1946, the president, Mr. G. Roche Lynch, referred to some of the principal developments in the work of the Institute. Closer contact with the four Dominion chemical institutes had been established through a meeting with their representatives which was held in London last June. The first edition of a "Directory of Independent Consultants in Chemistry and Related Subjects" was issued during the year. Highly successful courses in "Oils and Fats" and "Spectroscopy", arranged at the University of Liverpool by the Liverpool and North Western Section of the Institute, represented the first of the series of courses, conferences and symposia to be held under the auspices of the Institute as such. Through the generosity of Dr. David Spence, a series of Henderson Memorial Lectures had been established as a tribute to the memory of the late Prof. G. G. Henderson, a past president of the Institute; and the first lecture in this series was delivered by Sir Ian Heilbron. By agreement between the Ministry of Education and the Institute, the scheme for national certificates has been amended so as to provide separate certificates in chemistry and in applied chemistry. During 1946, the membership of the Institute (fellows and associates) passed the 10,000 mark. Mr. G. Roche Lynch was elected president for 1947–48.

"Specpure" and "H.S." Elements and Chemicals

CERTAIN metals and chemicals of the very highest purity for spectrographic work were first supplied on a small scale by Messrs. Adam Hilger, Ltd., in 1923, and their "H.S." and "Specpure" chemicals are now well known. With increased demand for more substances and greater quantities, it has been found desirable to transfer the preparation of these carefully standardized substances to Messrs. Johnson, Matthey and Co. The range of available chemicals, to be marketed as "H.S.", "Specpure" or "Matthey" standards, has been considerably extended; some sixty-eight elements are listed, either as metals, oxides or salts, in Johnson and Matthey's latest catalogue. They are all of the highest possible purity, and their manufacture is controlled spectrographically.

International Geological Congress, 1948

THE 18th Session of the International Geological Congress, originally planned for 1940 and postponed on the outbreak of war, is to be held in Great Britain in 1948, on the invitation of the Geological Society of London. A third circular containing preliminary arrangements for the session has been issued. Meetings will take place in London during August 25–September 1, 1948, and the following subjects have been provisionally listed for discussion: (1) Problems of Geochemistry; (2) Metasomatic Processes in Metamorphism; (3) Rhythm in Sedimentation; (4) Geological Results of Applied Geophysics; (5) Geology of Iron-Ore Deposits; (6) Geology of Petroleum; (7) Geology, Paragenesis and Reserves of the Ores of Lead and Zinc; (8) Geology of Sea and Ocean Floors; (9) Pliocene–Pleistocene Boundary; (10) Faunal and Floral Facies and Zonal Correlation; (11) Correlation of Continental Vertebrate-bearing Rocks; (12) Earth Movements and Organic Evolution. Geological excursions covering most of the British Isles, which are planned to take place between August 7 and September 18, form part of the Congress programme. They include sixteen long excursions (7–16 days) before the meetings in London, and sixteen of similar length after the meetings. There will also be daily excursions, centred on London, between August 22 and September 3. Sir Thomas Holland is president of the General Organising Committee and president-designate of the Congress. The general secretaries are Mr. A. J. Butler and Dr. L. Hawkes, and the treasurer is Mr. F. N. Ashcroft. All communications should be addressed to the General Secretaries, XVIII Session International Geological Congress, Geological Survey and Museum, Exhibition Road, London, S.W.7.

Summer School in Inorganic Micro-Chemistry

ALTHOUGH the advantages of small-scale methods of analysis have led to provision in various British universities and technical colleges for a certain amount of instruction in micro-techniques, it is believed that refresher courses for chemists who have not had recent contact with micro-methods would be of value (see also *Nature*, **156**, 588; 1945). Modern micro-methods are essential for attacking certain analytical problems, and in addition selected semi-micro and micro-methods offer advantages over more conventional methods in the teaching of practical chemistry to undergraduates. To provide practical experience in modern small-scale techniques, a summer school has been arranged at Queen's University, Belfast, during June 23–July 5. This course is planned to provide about seventy-five hours practical work. Particulars can be obtained from the secretary of the University.

Summer Course on Rheology

A SHORT summer course on rheology will be given at the Polytechnic, Regent Street, London, W.1, during July 28–31. It is specially designed for those engaged on rheological problems in industry, and the lectures will deal with general rheology, as well as with certain special applications. The lecturers will include Dr. G. W. Scott Blair and Dr. L. R. G. Treloar. Particulars may be obtained from Dr. J. Topping, Polytechnic, Regent Street, London, W.1.

Place of Universities in the Community

THE Division for Social and International Relations of Science of the British Association has arranged a conference on "The Place of Universities in the Community", to be held in the University of Manchester on May 10. The speakers will include: Lord Simon of Wythenshawe, Sir Henry Dale, Prof. J. D. Bernal, Prof. P. M. S. Blackett and Prof. M. Polanyi. Opportunity will be provided for other contributions to the discussion. Admission will be free, without tickets. Further particulars can be obtained from the secretary of the British Association.

Travelling Atomic Energy Exhibition

A TRAVELLING train exhibition is being organised by the Atomic Scientists' Association with the co-operation of the Ministry of Supply to illustrate the facts about atomic energy and its industrial applications in a simple and attractive manner. The train will visit fifty-five of the principal towns of Great Britain and take a year to complete the course. The information will be conveyed by charts, diagrams and photographs. It is also planned to show some simple experiments as well. At the various stopping places it is hoped to organise 'Atomic Weeks', which will include public discussions, in order to focus attention on the significance of the industrial revolution which will be brought about by the harnessing of atomic energy.

Comets

COMET Grigg–Skjellerup (1947*a*). E. L. Johnson, Johannesburg, recovered this comet on March 11, about 2° from the place predicted by F. R. Cripps in the "Handbook of the British Astronomical Association, 1947". Its magnitude was 11, but it will be a little brighter in May. An ephemeris is given below.

1947	0h R.A.	Dec.	r	ρ	Mag.
May 7	22h 38·1m	+17° 20′			
15	24·5	21 29	0·948	0·357	10·1
23	16·6	24 29			
31	10·4	+26 47	1·071	0·467	11·2

Two other comets have been discovered but are faint objects. Ephemerides are given for the month of May.

Comet Jones (1946*h*).

1947	0h R.A.	Dec.	r	ρ	Mag.
May 7	20h 08·6m	+34° 26′			
15	07·2	36 58	3·033	2·803	11·8
23	04·0	39 17			
31	19 59·1	+41 20	3·208	2·870	12·1

Comet Bester (1946*k*).

1947	0h R.A.	Dec.	r	ρ	Mag.
May 7	1h 43·7m	+25° 35′			
15	46·8	27 59	2·631	3·521	12·2
23	49·6	30 27			
31	51·9	+32 59	2·705	3·457	12·3

Announcements

PROF. P. M. S. BLACKETT, Langworthy professor of physics in the University of Manchester, will deliver a lecture on "The Magnetic Field of Massive Rotating Bodies" at a meeting of the Royal Society on May 15 at 4.30 p.m.

PROF. E. D. ADRIAN, professor of physiology in the University of Cambridge, will deliver the Alexander Pedler Lecture under the auspices of the British Association on May 14 at 5.30 p.m. The Lecture will be given in the Royal Institution, and Prof. Adrian will speak on "The Sense of Smell". Tickets are available on application to the secretary of the British Association.

IN connexion with the Pasteur Exhibition at the Science Museum, two public lectures will be given in the lecture theatre of the Museum on Pasteur and his work: Prof. J. D. Bernal will speak on "Pasteur, the Crystallographer" on May 14 at 5 p.m.; Dr. E. Chain on "Pasteur, the Biochemist" on May 19, also at 5 p.m.

MESSRS. KODAK LTD., Wealdstone, Harrow, Middlesex, have arranged an exhibition of applied photography to be held at Australia House, Strand, London, during May 7–16, 10 a.m.–5.30 p.m. (except May 10 and 11). The exhibition will be opened by Prof. E. N. da C. Andrade on May 6 at 11 a.m.

DR. F. D. OMMANNEY has been appointed by the Colonial Office to be marine biologist, Mauritius–Seychelles Fishery Survey.

THE Twelfth International Congress of Psychology, postponed from 1940, will be held in Edinburgh during July 23–29, 1948. Prof. James Drever is president of the Committee of Organisation, and Prof. Godfrey Thomson, Moray House, Edinburgh, 8, is general secretary. It will facilitate arrangements if those likely to attend will communicate with the general secretary.

AT the annual general meeting of the Gas Research Board, Viscount Falmouth was re-elected president for 1947–48, and Dr. Harold Hollings, controller of research of the Gas Light and Coke Co., has been appointed chairman in succession to Dr. E. V. Evans, who has resigned.

ERRATUM. In the communication "Plasma Cellular Reaction and its Relation to the Formation of Antibodies *in vitro*" in *Nature* of April 12, p. 499, the abbreviation 'pcs' used by the author in the heading of col. 6 of Table 1 was wrongly interpreted as 'plasma cells'; it should read 'pieces'.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

The Upper Milk Molars of the Ape-man, *Plesianthropus*

A FEW days ago I discovered at Sterkfontein remains of two new skulls of *Plesianthropus transvaalensis*. The specimens were found within a few feet of the spot where the type was discovered. One of the specimens is the crushed snout of apparently a young male with some beautiful teeth. The other is a fragment of the snout of a young child of about three years. This latter specimen has the milk molars shown in almost perfect condition.

Comparatively little study has been made of the milk molars of the different races of man, little on the milk molars of the living apes, and scarcely anything is known of the milk molars of the fossil apes.

LEFT MILK UPPER 1ST AND 2ND PREMOLARS OF *Plesianthropus transvaalensis* BROOM. TWICE NATURAL SIZE

The accompanying figure shows the two upper milk molars of *Plesianthropus*. If these be compared with figures I have given in the book on "The South African Fossil Ape-men" of the corresponding teeth in the Taungs ape-man *Australopithecus* and in a Bush-child, it will be seen that there is fairly close agreement. In fact, the teeth are practically identical in structure with those of the Bush-child.

In the 1st milk premolar, attention may be directed to the well-developed anterior outer accessory cusp, which is practically a human character, and to the presence of a Carabelli pit on the anterior inner main cusp.

In the 2nd milk molar there is not only a well-marked Carabelli groove, but also a well-developed Carabelli cusp. In the Bush-child tooth which I figured there is also a well-marked Carabelli cusp.

The Carabelli cusps on the inner and anterior side of the inner and anterior main cusp is a human character rarely, if ever, seen in apes, though what may be the homologue occurs in some lemurs; and the cingulum seen in *Proconsul* and some other early apes may be the factor that determines the Carabelli cusp.

The presence of a distinct Carabelli cusp on the 2nd milk premolar of *Plesianthropus* seems to show that this ape-man is very nearly related to man, and not closely related to the living apes.

R. BROOM

Transvaal Museum,
Pretoria.
April 12.

Normal Development of Fertilized Rabbit Ova Stored at Low Temperature for Several Days

WE are indebted to Ivanov[1,2], Walton[3,4], and Hammond[5] for the demonstration that mammalian spermatozoa can be kept at low temperature for some length of time without loss of fertilizing capacity. These observations gave rise to the new technique of artificial insemination in animal breeding, which is widely practised for live-stock improvement.

The viability of rabbit spermatozoa in the female tract following copulation[6] is only about 30 hours. However, rabbit spermatozoa can be kept alive *in vitro* for 96 hours at 10° C.[5], or 168 hours at 15° C.[4]. At body temperature, the maximum survival time *in vitro* is 13 hours[4]. Rabbit ova are capable of fertilization only for 6–9 hours[7,8] after ovulation *in vivo*.

In view of the fact that the life-span of spermatozoa is shorter at body temperature *in vivo* or *in vitro* than at low temperature *in vitro*, and in view of the fact that the delayed implantation of fertilized ova is fairly common in certain mammals (for example, Mustelidæ and Muridæ[9]), it was thought possible that the fertilized ovum could be kept *in vitro* at low temperature for a certain length of time without loss of its capacity for normal development.

Ova of super-ovulated rabbits[10] in the two-blastomere stage were stored in pure rabbit serum at low temperatures for varying lengths of time and then cultured for 24 hours at 37° C. to determine whether normal cleavage would occur. It was found that rapid cooling from 25° to 0° C., or to 5° C., followed by maintenance for 24 hours at the low temperature, was harmful to the subsequent viability of ova. On the other hand, slow cooling (from 25° to 0° C. in 5 hours, or from 25° to 5° C. in 4 hours) was considerably less harmful. However, there is no difference between rapid cooling and slow cooling from 25° to 10° C. These results indicate that the ova are subject to temperature shock upon rapid cooling, but can be acclimatized to lower temperatures by slow cooling. The latter procedure has been demonstrated by Chang and Walton on spermatozoa[11].

The optimal temperature for the survival of ova was found to be 10° C. (see table).

THE VIABILITY OF FERTILISED RABBIT OVA CULTURED AT 37° C. AFTER PRE-INCUBATION AT LOWER TEMPERATURES

Storage time (hours)	Storage temperature (° C.)	Per cent normal cleavage
24	0	63·4
	5	78·3
	10	82·2
	15	85·5
	25	37·2
72	0	48·1
	5	54·2
	10	58·8
	15	43·1
	25	0
120	0	0
	5	6·3
	10	36·5
	15	0
144	10	23·6
168	10	0

The normal cleaved ova cultured at 37° C. following low-temperature storage were transplanted[8] into the Fallopian tubes of doe rabbits, which had been injected with gonadotrophin 24 hours earlier to induce ovulation. In each instance, 4–15 ova were transplanted to each rabbit. After transplantation of ova stored at 0° C. for 78–102 hours, four litters of one

to two young each were delivered. Four litters (2–7 young) were delivered from eight recipient does following transplantation of ova stored at 5° C. for 48–80 hours. Four litters of one to four young were delivered from five recipient does after transplantation of ova stored at 10° C. for 80–101 hours. One litter of one young was obtained from two recipient does after transplantation of ova stored at 15° C. for 72 and 96 hours. All the young born were healthy, normal and genetically true to their real parents.

Finally, five does were transplanted with normal cleaved ova cultured at 37° C. for 24 hours after storage at 10° or at 5° C. for 120–144 hours; one of them gave birth to an abnormally small young at full term. Considering the small litter size in the cases of successful transplantation and the failure of pregnancy after longer times of ova storage, it is evident that the ova which cleave normally in culture are not necessarily sufficiently viable for full development.

This work is still being carried on to determine the efficacy of transplantation, and the detailed results will be published elsewhere. Considering the improbability of multiple birth after super-ovulation[12–21], and the possibility of application of the technique in animal breeding, these findings may open a new field for the full utilization of the germ cells of valuable animals.

The work was carried out in the laboratory of Dr. Gregory Pincus, to whom I am much indebted for advice and encouragement. Thanks are due to the Foundation for Applied Research, San Antonio, Texas, U.S.A., for a grant.

MIN-CHUEH CHANG
Worcester Foundation for Experimental Biology,
Shrewsbury, Massachusetts.
Feb. 25.

[1] Ivanov, E., *I. Arch. Sci. Biology*, **12**, 377 (1907).
[2] Ivanov, E., *C.R. Acad. Sci., Paris*, **183**, 456 (1926).
[3] Walton, A., *Nature*, **118**, 265 (1926).
[4] Walton, A., *J. Exp. Biol.*, **7**, 201 (1930).
[5] Hammond, J., *J. Exp. Biol.*, **7**, 175 (1930).
[6] Hammond, J., and Asdell, S. A., *J. Exp. Biol.*, **4**, 155 (1926).
[7] Hammond, J., *J. Exp. Biol.*, **11**, 140 (1934).
[8] Pincus, G., "The Eggs of Mammals" (The Macmillan Co., 1936).
[9] Asdell, S. A., "Patterns of Mammalian Reproduction" (Comstock, N.Y., 1946).
[10] Pincus, G., *Anat. Rec.*, **77**, 1 (1940).
[11] Chang, M. C., and Walton, A., *Proc. Roy. Soc.*, B, **129**, 517 (1940).
[12] Casida, L. E., Warwick, E. J., and Meyer, R. K., *J. Anim. Sci.*, **3**, 21 (1944).
[13] Casida, L. E., Meyer, R. K., McShan, W. H., and Wisnicky, W., *Amer. J. Vet. Res.*, **4**, 76 (1943).
[14] Cole, H. H., *Amer. J. Physiol.*, **119**, 704 (1937).
[15] Engle, E. T., *Proc. Soc. Exp. Biol. and Med.*, **25**, 84 (1927).
[16] Engle, E. T., *Endocrin.*, **15**, 405 (1931).
[17] Evans, H. M., and Simpson, M. E., *Endocrin.*, **27**, 305 (1940).
[18] Hammond, jun., J., Hammond, J., and Parkes, A. S., *J. Agric. Sci.*, **32**, 308 (1942).
[19] Hammond, jun., J., and Bhattacharya, P., *J. Agric. Sci.*, **34**, 1 (1944).
[20] Hammond, jun., J., *Nature*, **153**, 702 (1944).
[21] Parkes, A. S., *J. Endocrin.*, **3**, 268 (1943).

Hyaluronidase in Sea-Urchin Sperm

A SUBSTANCE liquefying the jelly-coat of sea-urchin eggs was first recovered from the sperm of sea-urchins by Hartmann and Schartau[1], who called it 'Androgamone II'. The enzyme nature of this substance was, however, denied[2]; moreover, it was pointed out that hyaluronidase from bull testis does not dissolve the jelly-coat of sea-urchin eggs[3]. On the other hand, an enzyme preparation from *Clostridium oed. mal.* was found to dissolve it[4].

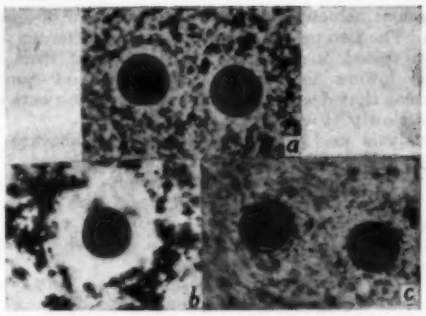


Fig. 1. EGGS OF *Sphærechinus gran.* IN INDIAN INK, IN ORDER TO MAKE THE JELLY-COAT VISIBLE: (*a*) NORMAL EGGS; (*b*) AFTER 3 MIN. ACTION OF A PREPARATION FROM *Arbacia* SPERM; (*c*) AFTER 13 MIN. THE JELLY-COAT IS COMPLETELY DISSOLVED

Recently, McClean and Rowlands[5], Fekete and Duran Reynals[6] and Rowlands[7] stated that hyaluronidase from the sperm of some animals (and from other sources, too) disperses the cumulus cells of mice and rat eggs. We therefore tried to find out whether the liquefying factor from the sea-urchin could be identified with hyaluronidase.

From sperm and testes of *Arbacia lixula* (= *pustulosa* Auct.) and *Sphærechinus gran.*, a substance was obtained which dissolves the jelly-coat of sea-urchin eggs and also lowers the viscosity of a mucin solution.

The preparation was made according to the technique of Claude and Duran Reynals[8]: that is, by extracting the ground material with $N/10$ acetic acid and precipitating with acetone. The precipitate was desiccated *in vacuo*. From 100 gm. of fresh material, 1 gm. of powder was recovered. This powder was dissolved in sea-water (*p*H *c.* 8) or in 0·85 per cent sodium chloride (*p*H *c.* 6·8). About 60 per cent of the powder remained undissolved and was removed by centrifuging. The ability of the solution (15 mgm. dry matter in 10 c.c. of solvent) to dissolve the jelly-coat of unfertilized sea-urchin eggs and to lower the viscosity of a mucin solution (in 0·85 per cent sodium chloride, *p*H *c.* 7) was tested. As a control, a preparation from bull testis and a total extract from heads of leeches was used.

The jelly-coat of unfertilized sea-urchin eggs (*Psammechinus, Sphærechinus, Arbacia, Paracentrotus*) swells as soon as the eggs are placed in the solution (Fig. 1 *b*), and after 10–15 min. it is completely dissolved (Fig. 1 *c*). A similar effect is shown by the extracts from heads of leeches. Preparations from bull testis, on the other hand, fail to dissolve the

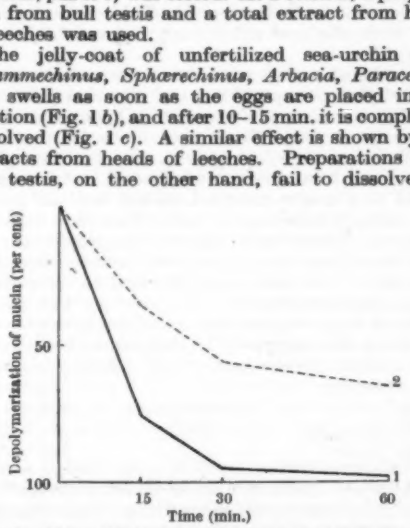


Fig. 2. MUCIN DEPOLYMERIZATION BY A PREPARATION FROM BULL TESTIS (1) AND FROM *Arbacia* SPERM (2)

jelly-coat, which swells only after one hour of incubation. The two preparations also act in different ways when tested on a mucin solution: that from bull testis lowers the viscosity strongly and quickly, whereas that derived from sea-urchin testis acts only very slowly (Fig. 2).

Dialysis and egg water do not inactivate our preparation. Tryptic activity was excluded. The power of the preparation to liquefy the jelly-coat and to depolymerize the mucin disappears on heating at 100° C. for 5 min.

A more detailed account and a discussion of these results will be given elsewhere[9].

A. Monroy

Zoological Station,
Naples.

A. Ruffo

Department of Biological Chemistry,
University of Naples.
Feb. 15.

[1] Hartmann, M., and Schartau, O., *Biol. Zbl.*, **59**, 571 (1939). Hartmann, M., Schartau, O., and Wallenfels, K., *Biol. Zbl.*, **60**, 398 (1940).
[2] Wallenfels, K., *Oest. chem. Z.*, No. 19/20 (1940).
[3] Runnström, J., Monné, L., and Broman, L., *Ark. Zool.*, **35** A, No. 3 (1943).
[4] Runnström, J., Tiselius, A., and Vasseur, E., *Ark. Kemi Min., Geol.*, 15 (1942).
[5] McClean, D., and Rowlands, J. W., *Nature*, **150**, 627 (1942).
[6] Fekete, E., and Duran Reynals, F., *Proc. Soc. Exp. Biol. and Med.*, **52**, 119 (1943).
[7] Rowlands, J. W., *Nature*, **154**, 332 (1944).
[8] Claude, A., and Duran Reynals, F., *J. Exp. Med.*, **65**, 661 (1937).
[9] *Pub. Staz. Zool. Napoli*, in the press.

Mutations in *Drosophila* Induced by a Carcinogen

Numerous attempts have been made by several geneticists to induce mutations in *Drosophila* by treating either eggs, larvæ, pupæ or adults with various chemicals. The first unquestionably positive results were obtained by C. Auerbach and J. M. Robson, who induced genetic changes in the sperm of males by exposure to the vapours of various mustards. There is very little doubt that the method of treatment developed by Auerbach and Robson contributed significantly to their success. This method can be used with chemical substances that can be handled as vapours.

For almost two years I have been working on a method that permits the use of chemical substances in solution. *Drosophila* males are kept in an atmosphere containing a fine ærosol of the solution being tested for mutagenic capacity. So far twenty-one substances have been investigated. An aqueous ærosol of nitrogen mustard (*HN*2) was the first to give positive results[1], indicating that the method is effective. Experiments are now in progress to test the mutagenic potency of several carcinogens, applied as ærosols of oil solutions. The first to be used was 1,2,5,6-dibenzanthracene. It gave positive results. Sperm of treated males was tested for X-chromosome lethals by the standard *ClB* method, and a considerable increase in the proportion of lethal mutations was observed.

	Chromosomes tested	Lethals	Per cent
Controls	7,755	3	0·04
Tests of 19 substances	47,028	18	0·04
Nitrogen mustard	5,491	90	1·67
1,2,5,6-dibenzanthracene	3,257	29	0·89

All lethals obtained in these experiments are being tested for chromosomal aberrations. The first results indicate that dibenzanthracene induces breaks in chromosomes as well as mutations.

Experiments with several carcinogens are now in progress, to determine if there is any correlation between carcinogenicity and mutagenic capacity in chemicals.

M. Demerec

Carnegie Institution,
Cold Spring Harbor, N.Y.
March 6.

[1] Carnegie Institution of Washington Year Book, **44**, 119 and 45, 158.

Selective Mating as a Factor for Speciation in Cichlid Fish of East African Lakes

In most of the modern texts on evolution[1], one of the outstanding proofs of speciation, that is, development of forms separated from one another under normal conditions by their immiscibility, without geographical isolation, is the very high number of species and genera of the Cichlidæ in almost every one of the great lakes in East Africa. This remarkable phenomenon (Woltereck's "*schizotypische Artaufspaltung*") is characteristic only for the Cichlidæ of the East African lakes; other genera of freshwater fish can be represented in the same area also by more than one species, but in no other family is the diversity of types—some of them being specialized to a certain mode of life and nutrition—so well developed as in the Cichlidæ.

A plausible interpretation of this fact is still wanting, because the many factors influencing the rapid tempo of evolution proposed up to this time (existence of predators, small number of individuals occupying a new niche, old age of the lake basin in question, etc.) do not fit all lakes in the same manner and, on the other hand, would be applicable also for fish of other families. So there must exist, with high probability, a special mechanism in the Cichlidæ favouring a splitting-up in smaller groups with preferred mating tendencies *intra se* not found in the other groups.

The Cichlidæ show in varying degrees very characteristic breeding-habits. Where in other fish there is parental care for the brood, generally only one of the parents is involved; in the majority of the cases it is the male that is concerned with defence, aeration, etc., of the eggs and care of the young fish. In the Cichlidæ, however, there are many cases where the two parents co-operate in their care for their brood. (In some of the genera, for example, in the mouth-breeders, only one of the sexes is involved.) Normally the two sexes live in monogamy[2], at least for the time of one brood, lasting from the beginning of nesting to the end of the family life with the fry which begin an independent life only some days or weeks after hatching. It is easily understandable that, by the introduction of a type of monogamy, even if it is only for one breeding period, a factor is involved which acts against panmixia. Furthermore, it is a well-known fact, which has been observed by a great number of fish-breeders, that in the selection of the mate there is a clearly visible preference between two individuals in a larger swarm of fish of the same species of Cichlidæ. The two mates, long before egg-laying begins, choose a certain corner of the aquarium and do not allow other fish to approach it. This fact proves that pair formation is not haphazard, but conditioned by some psychological factor which results in a strengthening of a relative sexual isolation of different pairs or families from one another. At least under aquarium conditions the continuity of the monogamic life of a male with a certain

female, even in the time between two breeding periods, is not an exception but the rule in certain South American Cichlidæ.

In this connexion it is interesting to note that the blind cavernicolous Cichlids of south-west Africa are of the mouth-breeding type, where only one of the two sexes is charged with the care for the brood, and not of that 'father *and* mother family' type of family care which seems to have been able to play an important part in the acceleration of species formation *in loco* in the Cichlidæ of the great East African lakes.

CURT KOSSWIG

Department of Zoology,
University of Istanbul.
Feb. 5.

[1] Worthington, E. B., "Geographical Differentiation in Fresh Waters with Special Reference to Fish", in "The New Systematics" (ed. by J. Huxley) (Oxford University Press, 1941).
[2] Kosswig, C., "Kontinentalverschiebungstheorie und Fischverbreitung", *C.R. Soc. Turque Sci. phys. nat.*, **11**, 5 (1944).

Feeding Mechanism of Water-Bugs

THE suggestion put forward by Walton[1] that the presence of small teeth and chitinous elevations in the pharynx of *Micronecta* indicates that this Hemipteran ingests and masticates particulate food material appears to be true for other families of the Cryptocerata. There exists in many, and probably all, species of Corixidæ a type of feeding mechanism which does not seem to have been recorded. This takes the form of a modification of the cibarial suction pump[2] in such a manner as to produce a pair of chitinous jaws having a structure and position strongly suggesting that they function as organs for the comminution of solid material. It is a mechanism more elaborate in form than that found in *Micronecta*. The whole ventral wall of the cibarial pump consists of a curved chitinous plate having a thickened posterior margin. The anterior border of this plate appears to be folded back and modified into a transverse triangular bar set with rows of minute tooth-like projections. Above this bar and articulating with it at its lateral ends lies a second chitinous bar formed by the thickened dorsal wall of the cibarium and similarly equipped with teeth or rugosities (Fig. 1). The two bars have the appearance of a pair of grinding jaws, and although the musculature of the organ has not been studied in detail, enough has been noted to support this supposition.

Some variation during the life-cycle in the importance of this mechanism for the grinding of food particles may exist, as in early instar nymphs (Fig. 2) the toothed surfaces are distinct, whereas in the imago, while the ventral plate and jaws are more heavily chitinized, the teeth appear to be less pronounced.

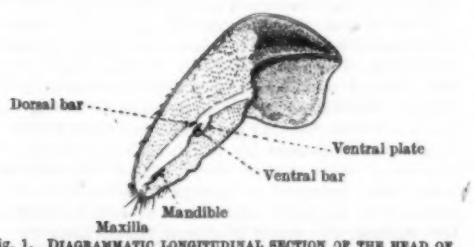


Fig. 1. DIAGRAMMATIC LONGITUDINAL SECTION OF THE HEAD OF *Sigara striata* TO SHOW DISPOSITION OF SCLERITES IN THE CIBARIAL PUMP

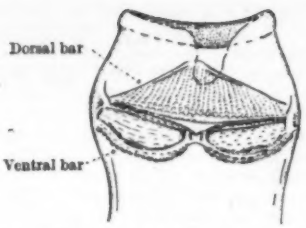


Fig. 2. DORSAL VIEW OF CIBARIAL PUMP IN NYMPH OF *Sigara striata*

The twelve species of *Corixa*, *Sigara*, *Clænocorisa* and *Cymatia* so far examined all show the structure with only minor variations in form between the species. A somewhat similar organ is present also in *Notonecta*, where, however, the teeth are replaced by bristle-like projections; in this family it may serve as a filter.

This is thought to be a type of food ingestion unique in the Hemiptera, and further investigation of the mouth parts and feeding in Corixidæ and Notonectidæ is being made for publication at a later date.

H. D. SLACK

Department of Zoology,
University of Glasgow.

[1] Walton, G. A., *Trans. Soc. Brit. Ent.*, **5** (7), 268 (1938).
[2] Snodgrass, R. E., "Principles of Insect Morphology" (New York, 1935).

Effects of High Temperature and Short Days on Vernalization Response of Summer Varieties of Rice

THE effect of high temperature on the acceleration of flowering in a number of varieties of rice has been reported previously[1,2,3,4]. In addition to early flowering, pre-sowing high-temperature treatment results in better resistance to drought conditions[5]. Vernalization by high temperature has practical difficulties. Radicles and plumules emerge from the seed coat during treatment, involving difficulty of transportation. This has been overcome in two varieties of rice noted below by limiting the moisture content of seeds to 30 per cent of fresh weight. Seeds at this moisture content germinated without the radicles and plumules penetrating the seed coat, and gave vernalization response when exposed to high temperature, 35° C., for 10 and 20 days (see table).

As regards the effects of day-length on flowering, a marked contrast between summer (Aus) and winter (Aman) varieties of rice has been noted by us. In previous communications in *Nature*[6,7], acceleration of flowering of winter varieties by short days has been reported by one of us, and this has been confirmed[4]. On the other hand, the effect of short days on summer varieties is different. The following results (see table) show that short days delay flowering and annul the effect of vernalization by high temperature. Pre-sowing high-temperature treatment accelerates flowering; but when this is followed by short-day exposure of seedlings, a reverse effect in the delay in flowering is noticed.

In the light of these findings, Kar's statement[4] that in different varieties of paddy warm temperature associated with short day-length is inducive to earliness, and cold temperature or longer day-lengths produces retardation, needs modification. In the

Summer (Aus) variety of rice	Treatments	No. of days from sowing to flowering	Acceleration (+) or retardation (−) of flowering as compared with control
Charnock	Series I		
	A	113·8	
	B	120·6	− 6·8
	C	109·6	+ 4·2
	D	121·4	− 7·6
	Series II		
	E	110·5	+ 2·5
	F	126·3	−13·3
	G	113·0	
Panbira	Series I		
	A	110·5	
	B	121·8	−11·3
	C	109·9	+ 0·6
	D	122·7	−12·2
	Series II		
	E	99·8	+ 7·8
	F	111·8	− 4·2
	G	107·6	

A, Control; *B*, 8-hour day for 4 weeks; *C*, 35° C. for 10 days; *D*, 35° C. for 10 days plus 8-hour day for 4 weeks; *E*, 35° C. for 20 days; *F*, 35° C. for 20 days plus 8-hour day for 4 weeks; *G*, control.

varieties examined by us, short days did not induce earliness but rather they have a devernalizing effect; also long days do not always retard, but sometimes accelerate, flowering, for the data for two Aus varieties presented in the statement[4] show acceleration by long days. It appears to us that Kar's results indicate that in Aus varieties long days, and in Aman varieties short days, tend towards the acceleration of flowering.

We desire to thank the Indian Council of Agricultural Research, New Delhi, for a grant in aid, and the Department of Botany, University of Calcutta, for laboratory facilities to carry out the investigation.

S. M. Sircar

Department of Biology,
University, Dacca.

B. N. Ghosh

Department of Botany,
University, Calcutta.

[1] Sircar, S. M., *Chron. Bot.*, in the press.
[2] Hedayetullah, S., and Sen, N. K., *Science and Culture*, **6**, 668 (1941).
[3] Hedayetullah, S., and Ghosh, B. N., *Nature*, **157**, 194 (1946).
[4] Kar, B. K., *Nature*, **157**, 811 (1946).
[5] Parija, P., *Curr. Sci.*, **12**, 88 (1943).
[6] Sircar, S. M., *Nature*, **153**, 378 (1944).
[7] Sircar, S. M., and Parija, B., *Nature*, **155**, 395 (1945).

Sunflower Stem Cultures for the Detection of Plant Hormones

Fragments of young stem tissue of *Helianthus annuus* (L.), when cultured on a nutrient medium containing 2 per cent sucrose and mineral salts, are capable of making only a limited amount of growth, chiefly confined to the production of a pad of callus tissue on the cut surface. Such cultures have been shown to respond in various ways to certain plant hormones. Root production results from the addition to the medium of one part per thousand million of such substances as indole acetic, indole butyric or naphthalene acetic acid to the agar on which such stem fragments are cultured. The type of root growth varies with the hormone used[1]. Higher concentrations of these substances cause a characteristic proliferation of the stem tissue. These reactions have already been used to demonstrate the presence of indole acetic acid in commercial penicillin. The crystalline penicillins *G* and *X* were shown to have root-initiating properties by this means, but to differ from indole acetic acid in that they failed to induce the same characteristic cellular proliferation at high concentration[2]. The reactions have also led to the detection of growth-substances in bacteria-free crown gall tissue.

The following method has been used for applying tests. Sunflower plants (var. Russian giant) were grown in pots until the first internode of the plant was fully expanded and the second was on the point of beginning to elongate. Such plants were cut off at the base and removed to the laboratory. By means of sterile forceps the epidermis was carefully stripped from the first internode, which was freed by this means of all external contaminants. The internode was then cut into segments of about 4 mm. in length by means of a sterile scalpel. Each segment was then transferred to an agar slope containing 0·8 per cent agar, 2 per cent sucrose, mineral salts (White's solution) and the substance to be tested. Tests so far have been carried out in 25 mm. × 150 mm. 'Pyrex' tubes containing 20 c.c. of agar. If the amount of material available was limited, it was incorporated into a few millilitres of agar, which was then cut into small blocks and applied to the cut surface of the stem fragment.

The sunflower stem fragments were taken from the upper half only of the internode, as tissue of the lower half tended to produce roots spontaneously. Material to be tested was always applied to the basal end of the fragment. If a root-producing substance had been added to the agar, root production was generally evident in about four days. A two-week period of growth was used when it was desired to detect the influence of a substance on the increase in fresh or dry weight of the fragment. Quantitative estimates of this kind were based on means from at least twenty samples. Histological effects of the unknown substances were also looked for.

R. S. de Ropp

New York Botanical Garden,
New York, 58, N.Y.
Feb. 26.

[1] de Ropp, R. S., *Amer. J. Bot.*, in the press.
[2] de Ropp, R. S., *Nature*, **158**, 555 (1946).

Sex Differences in Colour Vision

In a previous communication[1], it was shown that women with known colour-blind relatives were significantly more often red-green weak to a slight extent than women taken at random. This carried the implication that red-green blindness must be an incompletely recessive Mendelian character (although sex-linked), because a large proportion of the women with known colour-blind relatives must be heterozygous for that defect. Several later experiments have confirmed that conclusion, essentially the same results being obtained with each new group tested.

Another experiment, carried out on 191 men and 185 women with normal colour vision (but otherwise chosen at random), and 18 women with known colour-blind relatives, has confirmed the same conclusion in a different way. Sensitivities to the differences between red and green and between yellow and blue were measured by the limiting method, using monochromatic colour filters. The subjects tested were then grouped to compare men with women selected at random, and these women in turn with the women who knew of colour-blind relatives. The χ^2-technique showed a higher proportion of women than of men in the random samples, who had more

than twice the modal red-green threshold, on a probability-level of less than 0·001, although the modal threshold was the same for both sexes. Similarly, there were more women with twice the modal red-green threshold among those with known colour-blind relatives than among the random sample of women, on a probability-level of less than 0·01. In yellow-blue vision there were no significant differences, either between men and women, or between women at random and women with colour-blind relatives.

If we take Vernon and Straker's figure of 7·31 per cent of red-green defectives among men in Glasgow and the west of Scotland[2], which seems to be a likely proportion compared with other estimates for their frequency among white people[3,4], we may expect about 13·57 per cent of heterozygotes for sex-linked red-green defects among the population of women for the same area. In a sample of 185 women taken at random, we should expect about 25 heterozygotes. In the sample of 185 actually observed, there were 18 more women with twice the modal red-green threshold than there were men in the sample of 191 men, and this does not differ significantly from the 25 heterozygous women expected. This confirms the reliability of the test.

Although there are more major red-green defectives in the population of men than of women, there are more women than men with slight red-green weaknesses. This confirms the view that major red-green defects are sex-linked recessive characters, but incompletely recessive, so that most of the heterozygotes show the character to a slight degree. No sex differences of either kind can be found in yellow-blue vision.

R. W. Pickford

Psychology Department,
University, Glasgow.

[1] Pickford, R. W., *Nature*, **153**, 409 (1944).
[2] Vernon, P. E., and Straker, A., *Nature*, **152**, 690 (1943).
[3] Geddes, W. R., *Brit. J. Psych.*, **37**, 33 (1946).
[4] Grieve, J., *Nature*, **157**, 376 (1946).

The Name 'Penicillin'

The recent note "Aspergillin : a Name Misapplied to Several Different Antibiotics", in which Tobie[1] deprecates the practice of assigning names to antibiotics without due consultation of the literature, prompts me to point out, for its historical interest, that even penicillin has not escaped such a duplication in naming. I refer to the use of the name 'penicillin' by Palei and Osuicheva[2] in 1936 to designate a thermostable substance isolated from *Penicillium luteum purpurogenum*, which was unfavourable to the production of citric acid by *Aspergillus niger*. This was seven years after the first use of the term by Fleming[3] in his now famous paper. The oversight is probably due in part to the vagaries of indexing. The name 'penicillin' did not appear in *Chemisches Zentralblatt* until 1934, or in the British abstracts until 1933 ; it can, however, be found in the 1929 *Chemical Abstracts* and the *Biological Abstracts* for 1930. This serves as another warning against too much reliance on a single abstracting source.

Frank H. Stodola

Northern Regional Research Laboratory,
Peoria, Illinois.

[1] Tobie, Walter C., *Nature*, **158**, 709 (1946).
[2] Palei, T. Ya., and Osuicheva, A. G., *Proc. Inst. Sci. Res. Food Ind. (Leningrad)*, **3** (No. 4, 5), 146 (1936) ; *Chem. Abstr.*, **30**, 5250 (1936).
[3] Fleming, A., *Brit. J. Exp. Path.*, **10**, 226 (1929).

Emission of Secondary Charged Particles in Fission

It now seems fairly well established that in roughly 1 per cent of all fissions an α-particle is liberated at the moment of fission[1,2]. These secondary α-particles are mostly of small energy (< 2 MeV.), but some are found having energies greater than 20 MeV. It is obviously of interest to discuss the conditions in which such 'secondary' emission may occur.

As concerns the moment of liberation of the α-particle, the direct evidence from the tracks found in loaded emulsions is that an interval of time greater than about 3×10^{-13} sec. does not in general elapse between the instant of fission and the moment of liberation ; and the fact that directions of emission at right-angles to the line of separation of the fission fragments are more probable than any others is perhaps even more cogent, though less direct, evidence that the average time interval is much smaller than this. In any case, it is clear that, for α-particles of energy less than 2 MeV. and nuclei of medium atomic number, the half-value period for normal radioactive disintegration is enormously greater than 10^{-12} sec., so that these low-energy particles at least cannot be emitted spontaneously from nuclei which have already settled down to conditions of near-spherical symmetry after the main phenomena of fission have taken place.

We have to discuss, therefore, what is in effect ternary fission, with the third fission fragment assumed to be an α-particle in all cases : and we have to attempt to answer the questions, first, why protons are not as frequently emitted in similar events and, secondly, why ternary fission with α-particle emission is relatively so rare. For almost every other case of fission can plausibly be regarded as a case of ternary (or quaternary) fission, with a 'secondary' neutron as the third (or fourth) particle involved.

One possible approach to an answer might be to assume that since neutrons are in excess in the heavy nucleus in relation to all types of binary fission, the liberation of secondary neutrons is natural, and that when in rare cases protons also become free in the process of division of the compound nucleus, they coalesce with the 'nascent' neutrons to form an α-particle. Such a point of view has the advantage of tackling both questions at once, but the disadvantage that it requires the setting free of protons in pairs.

However, I favour another approach altogether—and it takes first the question why α-emission is relatively so rare. It is assumed that this rarity is connected with the fact that natural α-radioactivity does not appear with medium-heavy elements except within very restricted ranges of Z (atomic number). At present, only one 'naturally' α-active species has been definitely identified ($^{144}_{62}$Sm), but there is some evidence that ($^{148}_{61}$) may be another, and that a second narrow range of Z ($Z \sim 40$) may be found to include species which are α-unstable[3]. Also, from the practical point of view, the distinction should be made between the 'natural' α-activity of the medium-heavy elements which has remained undiscovered because the characteristic half-value period lies between, say, 10^3 and 10^9 years, or is greater than 10^{14} years or thereabouts ; and that which has hitherto escaped detection because of the much more probable positron activity of a species which is 'artificially' produced. Theoretically, of course, such a distinction is of no significance, but it may well reflect one aspect of the situation explaining possible gaps in our present knowledge.

The connexion between natural α-activity and the emission of secondary α-particles in fission is regarded as follows. It is considered that fission is essentially a 'binary' process—the division of the unstable compound nucleus into two fragments—and it is further assumed that any secondary effect occurs between the instant when the two fragments are first separate and the instant when for both the initial energy of deformation has been dissipated. We may hazard a guess that this may happen within a time of the order of 10^{-20} sec. So far as the secondary neutrons are concerned, this point of view is consistent with the observed fact that the energies of the secondary neutrons are on the whole considerably greater than the energies of the so-called delayed neutrons[4,5], an effect to be expected if the former are emitted from fission fragments moving with high velocities whereas the latter are emitted from nuclei which have already been brought to rest[6].

As concerns the emission of secondary α-particles, taking this view of the matter, it is considered that the initial phase of separation of the fragments provides an opportunity for the emission of particles from deformed nuclei in a time which would be altogether too short for normal 'radioactive' disintegration. However, the conditions which must obtain to render such emission at all probable are satisfied only when the primary fission fragment is a nucleus which is α-unstable in its ground-state—or nearly so, for it must be remembered that, in the initial phase considered, the fragment nucleus is not only deformed but also endowed with considerable energy of excitation. Since it appears to be a general rule that the maximum α-instability for Z constant occurs for a small rather than a large value of A (mass number)[7], these conditions for α-emission will be seen to require modes of binary fission in which the 'excess' neutrons are shared very unevenly between the fragment nuclei. That such modes of fission must occur, however, is known from the identification of $^{92}_{35}$Br, $^{96}_{37}$Rb and $^{136}_{55}$Cs as primary fission products[8]. In the very rare modes of fission (relative probabilities 10^{-7}–10^{-4}) in which these species are produced, the disparity in respect of neutron excess in the fragments is extreme: neglecting secondary neutron emission, it would appear to be 1 : 15, 1 : 17 and 3 : 15, in the three cases in question. However, in these cases the fragment nuclei are of odd atomic number; for division into fragments of even atomic number, the total neutron excess would be considerably smaller. For fragment nuclei of charge numbers 40 (Zr) and 52 (Te) or 60 (Nd) and 32 (Ge), for example, the masses of the stable isotopes are such that a total excess of 10 neutrons, only, has to be disposed of by sharing between the fragments and by secondary emission in each case. If, therefore, we accept the narrow ranges of atomic number around $Z \sim 40$ and $Z \sim 60$ as ranges of possible α-instability, it would appear reasonable, on the basis of present knowledge of the dependence of fission yield upon mass number[9], and of the general point of view outlined above, to attribute the more abundant secondary α-particles of low energy to emission from fragment nuclei belonging to the lower range of Z ($Z \sim 40$), and the less abundant but more energetic secondary α-particles to emission from nuclei having $Z \sim 60$.

It might be remarked that since the above was written, I have noticed the announcement[9] of the release of a preliminary American report by Farwell, Segrè and Wiegand dealing with the long-range secondary α-particles. This report does not appear as yet to be available in Great Britain. A publication by Demers[10] has also come to hand.

Finally, thanks should be recorded to Messrs. Green and Livesey for their kindness in communicating their results before publication.

N. Feather

Department of Natural Philosophy,
University, Edinburgh. Feb. 20.

[1] Tsien, Chastel, Ho and Vigneron, *C.R. Acad. Sci. Paris*, 223, 986 (1946).
[2] Green and Livesey, *Nature*, **159**, 332 (1947).
[3] Feather, "Nuclear Stability Rules" (Camb. Univ. Press), in preparation.
[4] Halban, Joliot and Kowarski, *Nature*, **143**, 680 (1939).
[5] Burgy, Pardue, Willard and Wollan, *Phys. Rev.*, **70**, 104 (1946).
[6] Bohr and Wheeler, *Phys. Rev.*, **56**, 426 (1939).
[7] Feather, *Proc. Roy. Soc., Edin.*, **62**, 211 (1946).
[8] Siegel, *J. Amer. Chem. Soc.*, **68**, 2411 (1946) (Plutonium project report).
[9] *Bull. Atomic Scientists (U.S.A.)*, **3**, 28 (1947).
[10] Demers, *Phys. Rev.*, **70**, 974 (1946).

Spontaneous Fluctuations of Current in a Photo-Electric Cell

Data on the fundamental electrical Brownian movement arising in a high-vacuum photo-cell appear to us to be rather scanty. In the saturated condition, on the plausible assumption that all the emitted electrons proceed to the anode randomly and independently, one might expect the familiar Schottky formula[1] to be obeyed by the current fluctuations, namely:

$$\overline{(i - I)^2} = 2eI\Delta f, \quad . \quad . \quad . \quad (1)$$

where i is the instantaneous current, I is the mean current, Δf the band-width of the measuring instrument.

B. A. Kingsbury[2] reports some measurements giving a value of $\overline{(i - I)^2}$ 25 per cent higher than the theoretical prediction. This work may well have been marred by 'flicker effect'[3,4]. W. A. Harris[5] states baldly that equation (1) will be fulfilled, without reference to experimental data.

In the space-charge limited region where only a portion of the emitted electrons reaches the anode, formula (1) will, in analogy with the well-known facts about the 'shot effect' in thermionic valves, be replaced by

$$\overline{(i - I)^2} = 2eI\Gamma^2\Delta f, \quad . \quad . \quad . \quad (2)$$

where the factor $\Gamma^2 < 1$ is usually termed the 'space-charge reduction factor'. As the space-charge reduction effect must vanish in the 'retarding field' region for very small currents, $\Gamma^2 = 1$ should hold in the latter case and in the saturation region (according to (1)), and it should have a minimum value somewhere in the space-charge region.

These predictions are verified by the results of an investigation on the shot effect in photo-electric cells which is being carried out by one of us (D. K. C. McD.). Fig. 1, representing the dependence of Γ^2 on I in the saturation region, shows clearly that $\Gamma^2 \to 1$ for the saturation condition within the limits of experimental error. Fig. 2, referring to the region of very small currents with considerable space-charge limitation, shows that Γ^2 indeed increases with decreasing current within this region, and tends towards unity for very small currents.

On the basis of measurements of the spectral response of the type of photo-cell used in these experiments, and assuming a black-body intensity

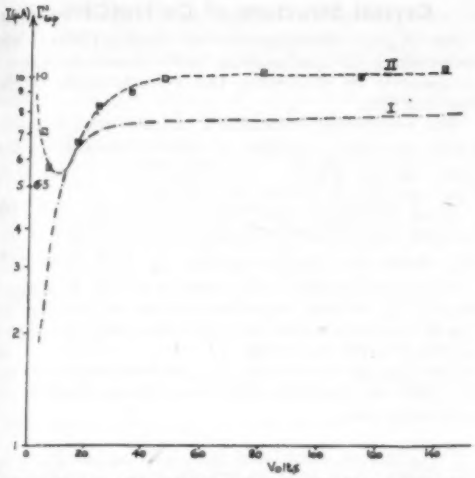


Fig. 1. CHARACTERISTIC OF THE PHOTO-CELL (CURVE I, LEFT-HAND SCALE) AND SPACE-CHARGE REDUCTION FACTOR Γ^2 OF THE SHOT EFFECT (CURVE II, RIGHT-HAND SCALE) AS A FUNCTION OF ANODE VOLTAGE

distribution in the spectrum of the illuminating incandescent lamp, one of us (R. F.) has shown that the energy distribution of the photo-electrons is roughly 'Maxwellian', corresponding to a 'temperature' of about 2,000° K., which is lower than the filament temperature of the lamp, as one might expect.

Using the theory of space-charge-reduced noise developed by D. O. North[6], the electron 'fluctuation temperature' was estimated from the experimental data for Γ^2. Extrapolation to zero current ($\Gamma^2 = 1$) gives a temperature $\sim 3{,}000°$ K. As this shows agreement in order of magnitude with the 'electronic temperature' estimated above from quite different observations, we may thus reasonably conclude that the usual shot effect theory is valid for the saturation and 'retarding-field' regions.

In the intermediate region, however, the apparent fluctuation temperature is found to vary, increasing with current I; hence North's theory is not directly applicable here.

The most probable explanation lies in the fact that the whole of the emitting surface is not uniformly illuminated; the behaviour will thus be analogous to that of a thermionic valve with part of the cathode at a temperature lower than the rest. Therefore, in this region the observed Γ^2 would be greater than the anticipated value; agreement with theory can thus only be expected in the two extreme regions.

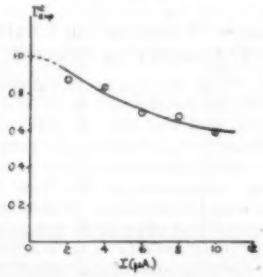


Fig. 2. SPACE-CHARGE REDUCTION FACTOR AS A FUNCTION OF CURRENT (UNDER STRONG ILLUMINATION) IN THE REGION OF EXTREME SPACE-CHARGE LIMITATION

We hope to present a fuller treatment at a future date, and one of us (D. K. C. McD.) has commenced work on measurements of fluctuations using monochromatic radiation and low temperature for the cell.

The assistance of the General Electric Co., Ltd., Wembley, in supplying the photo-cells for this investigation is gratefully acknowledged.

R. FÜRTH

Physics Department,
Birkbeck College,
University of London.

D. K. C. MACDONALD

Clarendon Laboratory,
University of Oxford.
Feb. 25.

[1] Schottky, W., *Ann. Phys.*, **57**, 541 (1918).
[2] Kingsbury, B. A., *Phys. Rev.*, **38**, 1458 (1931).
[3] Johnson, J. B., *Phys. Rev.*, **26**, 71 (1925).
[4] Schottky, W., *Phys. Rev.*, **28**, 74 (1926).
[5] Harris, W. A., *R.C.A. Rev.*, **5**, 515, 525 (1941).
[6] North, D. O., *et. al.*, *R.C.A. Rev.*, **4**, 5 (1941).

Identification by X-Rays of Interface Compounds on 'Oxide' Cathodes

A RECENT paper by Fineman and Eisenstein[1] has presented interesting observations concerning the interfacial films formed between coating and metal core material on alkaline earth oxide-coated cathodes. Nickel alloys containing impurity elements such as magnesium, aluminium or silicon (or like elements) are commonly employed for these cathodes, and it has been accepted for many years that the process of activation is facilitated by the presence of one or other of the above impurities[2]. Chemical reaction with the alkaline earth oxide at elevated temperatures frees barium ions which are required for the development of the thermionic emission.

The detection and identification of the interfacial reaction products, if such be formed, are of importance from several points of view. For one thing the detection of the interfacial film reveals that chemical reaction does occur, and the nature of the compound formed shows what constituents of coating and core metal take part in the reaction. For another, the identification of the film will enable measurements of resistivity to be made, a physical property which is regarded as playing a considerable part in the behaviour of 'oxide' cathodes. This is to mention but two of the factors which make studies of the interface of these cathodes of interest.

The technique of X-ray analysis has been used by Fineman and Eisenstein to examine the 'oxide' cathode 'interfaces'. This method has also been employed in these Laboratories with successful results. A reference to an identification of the interface for a base metal consisting of nickel alloyed with a small percentage of aluminium was made in a paper to the Royal Society of Arts in 1940[2]. Because of the recent rise of interest in this feature of 'oxide' cathodes, it has been thought worth while to summarize the results so far obtained.

A variety of specimens has been studied, both from experimental diodes and from more formal thermionic devices, and three principal base metals have been included, namely, nickel containing aluminium, silicon and titanium respectively. The 'oxide' coating was invariably formed from a barium–strontium carbonate solid solution of the conventional type, in which barium and strontium carbonates were present in equimolecular proportions. After vacuum

processing and activation of the cathodes, the thermionic devices were opened to the atmosphere, and then the coatings scraped away so as to expose the interface at the base metal. No special precautions have been taken to prevent reaction of the interface compound with the atmosphere.

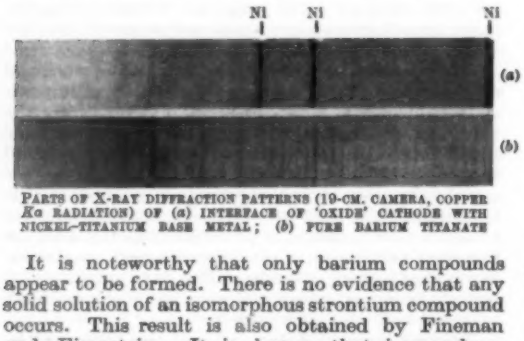
X-ray examination was carried out in most instances by glancing-angle reflexion technique, using copper $K\alpha$ radiation and a circular camera of 19 cm. diameter. In one or two instances the interfacial film was thick enough for filings to be made, but X-ray analyses of such specimens did not yield results differing in any significant respect from that obtained by the surface reflexion technique.

The results are presented in tabulated form below :

Base-metal	X-ray analysis	Standard of comparison made from :
Nickel with 2 per cent aluminium	Barium aluminate, $BaO.Al_2O_3$	Equimolecular proportions of $BaCO_3$ and Al_2O_3 heated to 1,200° C. in air
Nickel with 0·4 per cent silicon	Barium orthosilicate, Ba_2SiO_4*	Mixture of $BaCO_3$ and SiO_2 (finely ground flint) in molecular ratio 2 : 1 heated to 1,300° C. in air
Nickel with 0·23 per cent titanium	Barium orthotitanate, Ba_2TiO_4	Mixture of $BaCO_3$ and TiO_2 in molecular ratio 2 : 1 heated to 1,300° C. in air.

* In Fineman and Eisenstein's paper the interface compound is stated to be "$BaSiO_3$" ; but after correspondence, they agree with the results reported here.

The accompanying photograph illustrates the X-ray identification of barium orthotitanate as the interface compound on an 'oxide' cathode in which a nickel–titanium alloy was the base metal.



PARTS OF X-RAY DIFFRACTION PATTERNS (19-CM. CAMERA, COPPER $K\alpha$ RADIATION) OF (*a*) INTERFACE OF 'OXIDE' CATHODE WITH NICKEL–TITANIUM BASE METAL; (*b*) PURE BARIUM TITANATE

It is noteworthy that only barium compounds appear to be formed. There is no evidence that any solid solution of an isomorphous strontium compound occurs. This result is also obtained by Fineman and Eisenstein. It is known that isomorphous replacement of barium by strontium can occur with the orthosilicates and orthotitanates prepared for comparison purposes.

Another interesting crystallographic feature is that barium orthotitanate and barium orthosilicate appear to be structurally isomorphous. This is shown by the very close similarity in their Debye–Scherrer powder photographs. Of the two compounds the titanate has the larger lattice parameters. It is not known whether this crystallographic similarity has any significance so far as the thermionic behaviour is concerned.

H. P. ROOKSBY

Research Laboratories,
General Electric Company, Ltd.,
Wembley.

[1] Fineman, A., and Eisenstein, A, *J. Appl. Phys.*, **17**, 663 (1946).
[2] Benjamin, M., *Phil. Mag.*, **20**, 1 (1935).
[3] Rooksby, H. P., *J. Roy. Soc. Arts*, **88**, 318 (1940).

Crystal Structure of $Co[Hg(CNS)_4]$

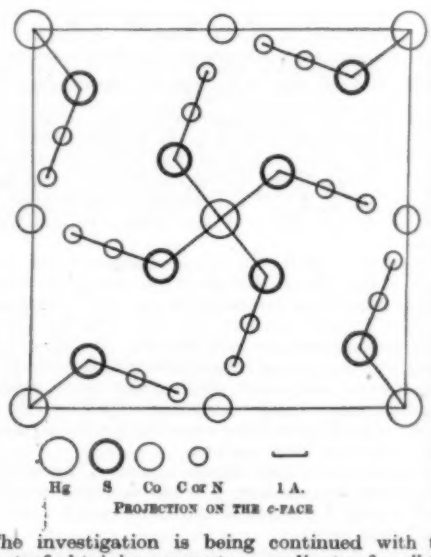
AN X-ray investigation of $Co[Hg(CNS)_4]$ was undertaken in conjunction with work on similar compounds to determine the co-ordination of the complex ion.

The compound crystallizes in deep purple, tetragonal, prismatic needles of crystal class $\bar{4}(S_4)$ and space group $I\bar{4}(S_4^2)$. $a = 11{\cdot}09$ A.; $c = 4{\cdot}37$ A. There are two molecules per unit cell.

From Patterson and Fourier syntheses of the $hk0$ and $h0l$ zones, the co-ordinates of Hg, Co and S are: Hg: 0,0,0; Co: $\frac{1}{2},0,\frac{1}{4}$ *or* $\frac{1}{2},0,\frac{3}{4}$; S: 0·15, 0·13, 0·28.

This gives an Hg—S distance of 2·5 A. It appears reasonably certain that the S atom is attached to the Hg in tetrahedral co-ordination, with S—Hg—S angles of 120° and 104°.

The indications of the Fourier syntheses are that S—C≡N is straight, with N co-ordinated about Co (see diagram).



PROJECTION ON THE *c*-FACE

The investigation is being continued with the object of obtaining accurate co-ordinates for all the atoms.

J. W. JEFFERY

Birkbeck College Research Laboratory,
21–22 Torrington Square,
London, W.C.1.
Feb. 27.

Effect of Shape of Operating Chamber in the Freeze-drying Process

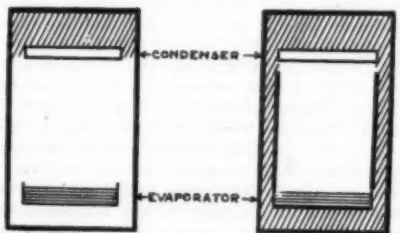
A RECENT communication[1] discusses the freeze-drying process as conducted with the pressure of permanent gas, and the vapour pressure of the ice on the condenser, maintained at very low levels. Research on the application of the process to foodstuffs is being conducted at the Low Temperature Research Station, Cambridge. It seemed likely that the need to operate at extremely low pressures might be undesirable economically in such applications, and accordingly other factors which affect the efficiency of the process have been investigated, including air pressures up to 1 mm. mercury and condenser temper-

atures of −20° C. and higher. The results show, as will be made clear below, that the design of the space in which freeze-drying is proceeding materially affects efficiency.

Using a frozen mixture of copper filings and boiled, distilled water as the evaporator in order to reduce temperature gradients, it is found that the vapour pressures in the immediate vicinity of the evaporating and condensing surfaces are sensibly equal to the saturation vapour pressures of ice at the temperatures of these surfaces. The air in the system distributes itself in such a way that the total pressure is everywhere the same, provided mechanical obstruction is negligible, so that more air collects near the condenser than near the evaporator. The variation of the partial pressure of air p from the evaporator to the condenser follows the law $p = A \exp. Bx$, where x is the distance from the evaporator, and the mean air pressure in the system can be calculated from the formula $\pi = \dfrac{p_c - p_l}{\log_e (p_c/p_l)}$, where p_c, p_l are the partial pressures of air near the condenser and evaporator respectively. It is presumed that this distribution of partial pressures results from a general movement of the mixture of air and vapour from the evaporator to the condenser, due to a difference in total pressure which is too small to be measured, together with movements of air and vapour by diffusion under their own gradients of partial pressure.

If a certain rate of heating be applied to the evaporator, its temperature takes up a value such that the resulting rate of drying removes an equal amount of latent heat. If the system is 'efficient' this will be achieved at a comparatively low temperature; an inefficient system will result in a high temperature. A convenient index of 'efficiency' in this sense is provided by the difference Δp between the vapour pressures at the evaporator and condenser which is set up when a standard rate of evaporation is maintained. It is found that Δp is directly proportional to the mean air pressure π over the range investigated (0·01–1·0 mm. mercury), so that from this point of view the amount of air in the system should be reduced to a minimum.

It has been mentioned that the partial pressure of air near the condenser is relatively high. Any space in the system which is 'screened' by the condenser also contains air at this pressure; and if this space is large, a substantial proportion of the air in the system will be driven into it when evaporation commences, so that the air pressure in the rest of the system will be considerably reduced. In this way a low value of Δp can be obtained even though the total amount of air in the system may be comparatively high. For example, a simple system such as that shown in (*a*) of the diagram gave $\Delta p = 1{\cdot}7$ mm.



CROSS-SECTIONS OF SIMPLE CYLINDRICAL DESICCATORS. THE AREAS SHADED ARE SCREENED BY THE CONDENSER

at a mean air pressure of 0·9 mm.; the addition of a tube as shown in (*b*) produced a considerable increase in the volume screened by the condenser, and a value of $\Delta p = 1{\cdot}1$ mm. was obtained.

The appearance of the condensed ice varies with the air pressure and the temperature of the condenser. At low pressures and temperatures, the formation is similar to that described by Bradish *et al.*[1] with a slightly milky appearance. At temperatures of −10° C. and thereabouts, with low air pressures, a glassy, transparent deposit of maximum density is obtained. At air pressures in the neighbourhood of 0·5 mm. mercury, the deposit is milky with a surface of flat, crystalline facets up to 3 mm. across; and pressures of 1 mm. mercury and above give a completely opaque, 'granular' deposit.

Further work in progress includes an investigation into the drying characteristics of various foodstuffs.

A. J. EDE

Low Temperature Research Station,
Downing Street,
Cambridge.
Feb. 28.

[1] Bradish, C. J., Brain, C. M., and McFarlane, A. S., *Nature*, **159**, 28 (1947).

Velocity of Electromagnetic Waves

THE determination of the velocity of light has attracted the attention of many scientific workers and, in spite of the experimental difficulties involved, its value is now known with a probable error of about 5 parts in 10^5. The velocity of electromagnetic waves, represented in Maxwell's theory by the quantity $1/\sqrt{\mu k}$, where μ is the permeability and k the permittivity of the medium, is generally assumed to have the same value as that of light; and although the electrical measurements made so far are less accurate than those of the velocity of light, they have served to establish the equality of the two constants within the limits of experimental error. Other electrical methods have become practicable as a result of the techniques employing centimetric waves developed during the last few years. The one dealt with in this note depends on the electrical resonance of a short length of a wave-guide closed at both ends. The frequency of resonance of a cylindrical guide of diameter D and length L is

$$f_n = v \sqrt{\left(\frac{r}{\pi D}\right)^2 + \left(\frac{n}{2L}\right)^2},$$

in which v represents $1/\sqrt{\mu k}$, r is a constant for a particular mode of resonance and n is the number of half wave-lengths in the guide.

This formula is based on the assumption that the walls of the guide are perfectly conducting. Their finite conductivity can be taken into account by introducing a small correction factor in terms of Q, the quality factor, of the resonator. The value of v then becomes

$$v = f_n \left(1 + \frac{1}{2Q}\right) \Big/ \sqrt{\left(\frac{r}{\pi D}\right)^2 + \left(\frac{n}{2L}\right)^2}.$$

The quantities f_n, D, L and $\left(1 + \dfrac{1}{2Q}\right)$ can all be measured with a precision of a few parts in 10^6, and the accuracy of a single measurement should therefore compare favourably with that of the velocity

of light, which is based on a large number of observations.

Measurements of the velocity in a vacuum have been made, using the E_{010} and E_{011} modes in one particular resonator. The values of the velocity term obtained for the two modes differ by 2 parts in 10^5, the average value for the velocity of electric waves in a vacuum being

$$v_0 = 299{,}793 \text{ km./s.}$$

The maximum error, including residual effects due to the method of coupling the resonator to a source of oscillations, is estimated to be $\pm$ 3 parts in 10^5, which is approximately $\pm$ 9 km./s.

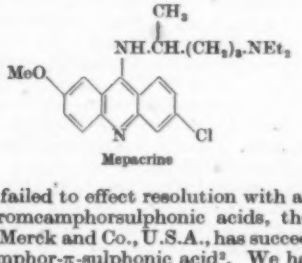
The value of velocity is 17 km./s. greater than that generally accepted for the velocity of light, although the values are not in disagreement when the combined limits of error are taken into account. In view of the possible discrepancy, however, it is proposed to make measurements of other modes in resonators of different shapes, in order to obtain further experimental evidence of the possible sources of error.

L. Essen

National Physical Laboratory,
Teddington.
Feb. 19.

Resolution of Mepacrine

Mepacrine (2-chloro-5-(3-diethylamino-α-methylbutyl)amino-7-methoxyacridine) has been resolved by Tschelincev and Osetrova[1], by the use of what they describe as αα′-bromcamphorsulphonic acid.



Mepacrine

We have failed to effect resolution with any of the available bromcamphorsulphonic acids, though Dr. Trenner, of Merck and Co., U.S.A., has succeeded with *d*-α-bromcamphor-π-sulphonic acid[2]. We have, however, carried out a complete resolution by means of *d*-4 : 6 : 4′ : 6′-tetranitrodiphenic acid. Full details will be given in another place; in the meantime, we wish to record our values for the specific rotation of the hydrochlorides of the optical antimers in water. We find:

$[\alpha]_D^{16°} = -379 \pm 6°$ (m.p. 244–5°, decomp.; uncorr.).

$[\alpha]_D^{16°} = +388 \pm 7°$ (m.p. 244–5°, decomp.; uncorr.).

Tschelincev and Osetrova[1] give:

$[\alpha]_D = -357°$ (m.p. 243°, decomp.).

$[\alpha]_D = +358{\cdot}6°$ (m.p. 243°, decomp.).

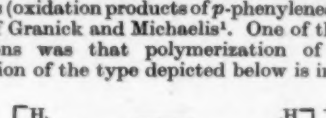
B. R. Brown
D. Ll. Hammick

Dyson Perrins Laboratory,
Oxford.
Feb. 27.

[1] Tschelincev and Osetrova, *J. Gen. Chem. (Russ.)*, **10**, 1978 (1940).
[2] Bacher, Buhs, Hetrick, Reiss and Trenner, *J. Amer. Chem. Soc.*, April 1947.

Polymerization of a Semiquinone Ion

The most recent theory of the structure of Wurster type dyes (oxidation products of *p*-phenylenediamines) is that of Granick and Michaelis[1]. One of their main conclusions was that polymerization of a semiquinone ion of the type depicted below is impossible



when all the amino hydrogens are substituted. In support of this conclusion, they instanced the existence of a crystalline perchlorate of Wurster's Blue (the oxidation product or δ-salt of tetramethyl paraphenylenediamine)[2] the paramagnetism of which indicates the presence in the molecule of one unpaired electron.

By oxidizing tetramethylbenzidine with aqueous bromine in the presence of sodium perchlorate, we have prepared a deep-green crystalline perchlorate which catalytic micro-reduction shows to be on the oxidation level of a semiquinone. The striking thing about this green salt is that it is diamagnetic ($\psi_M = -166 \times 10^{-6}$ c.g.s. units). Thus polymerization of this semiquinone ion occurs in spite of the fact that all the amino hydrogens are substituted. It is clear that some modification of the existing theory of polymerization of semiquinone ions of the above type is required. Details of proposed modifications and work on related compounds will be published shortly.

G. K. Hughes
N. Hush
D. P. Mellor

Department of Organic and Applied Chemistry,
Department of Chemistry,
University of Sydney.
Feb. 27.

[1] Michaelis, L., and Granick, S., *J. Amer. Chem. Soc.*, **65**, 1747 (1943).
[2] The paramagnetism of the perchlorate of Wurster's Blue was first studied by H. Katz, *Z. Phys.*, **67**, 242 (1933).

Size Versus Colour in Air-Sea Rescue

I am indebted to the Air Ministry and especially to the civilian staff of the Air-Sea Warfare Development Unit for a copy of the valuable report on "The Optimum Dinghy Colour for Air-Sea Rescue". Colours were tried from a yellow close to the Schott glass O.G.1, through orange and fire orange, near Schott O.G.2, onwards to traffic red and post-office red, like Schott R.G.1. The overall average visual range of the five coloured *M*-type dinghies for all-round weather conditions around the British Isles was approximately 1·7 nautical miles (3·15 km.). The waters were mostly greenish, but this is not always so on our coasts.

For the blue Mediterranean the visual ranges were, yellow dinghy 4 naut. miles (7·41 km.); orange and fire orange, 3 naut. miles (5·56 km.); reds, 2·5 naut. miles (4·63 km.). These are significantly different. But there was no such difference between the maximum visibility distance as a definitely coloured object on any sea colour. On green and blue seas, the observers favoured dinghies which appeared orange. This agrees with my own observations using the Schott glasses at sea, for the clearest view is obtainable with O.G.2.

After preliminary tests, the observations were made at 240 m. The diameter of the dinghy being 2·5 m. the angular size at the limiting ranges was, as the report points out, of the order of 0·05°. Actually the size is about one minute of arc for the greatest range (7·4 km.), nearly two minutes for the red range (4·6 km.) and nearly seven minutes for the British waters range (3·15 km.). Now Helmholtz has shown that the minimum perceptible brightness difference increases from about 2 per cent for an angular size 3° ; from his curve one finds (by extrapolation) that the minimum perceptible brightness difference has increased to about 40 per cent for the 7-km. range, about 35 per cent for the 5·5-km. range and for the 3-km. range to about 27 per cent. As the effect of the atmosphere is to introduce a greyness into the colours, it is clear that the high values of the minimum perceptible brightness differences are the real limits to vision. Put simply, the objects become too small to see, quite irrespective of their colour.

It should be possible to increase the 'size' of the object by liberating oil. In the past, use has been made of fluorescein powder, which should the "multitudinous seas incarnadine", and this has been given off by airmen's suits (namely, packet on life-jacket). But the colour is obviously soon diluted, and in any event a volume effect is produced as against a surface effect for oil. The action of the latter is, according to N. K. Adam, "to damp out the small ripples which are constantly being formed by the action of wind". The water surface at a distance makes, therefore, a smaller average angle with the eye, and so its reflexion is greater. This reflexion amounts to 40 per cent for 5°, and is increasing rapidly as the angle between sea and line of sight diminishes. There is, in addition, the difference due to the refractive indices of oil and water; but a trial on calm water showed this to be negligible. I am indebted to Prof. Adam for the guess that a fuel oil will spread to a thickness of at most one micron on a clean sea ; at this one should have the higher orders of interference colours, which are surely observed. One kilogram of oil would, therefore, cover at least 1,000 sq. metres, giving a patch 30–40 m. in diameter. At the farthest range observed, namely, 7·4 km., such a patch would subtend an angle of about 15′, corresponding to a minimum perceptible brightness difference of about 17 per cent, as against 40 per cent for the dinghy ; for British waters, 3·15 km., the angle would be 35′, corresponding to a 7 per cent minimum brightness discrimination. Thus increase in size should considerably extend the visual range, for dinghies plus oil, as against dinghies alone.

An obvious method of increasing the angular dimensions of an object is, of course, to use field-glasses; but it appears that the limitation of the field of view renders them valueless in ocean search —at least, no mention was made of them in the report.

The rate of spreading of oil on water may be about 12 m. a minute[1], so were a dinghy to liberate oil on sighting an aeroplane, a good-sized patch should rapidly be produced. So many factors are concerned in trials of this sort that direct observation seems the only way to reach a conclusion.

W. R. G. Atkins
Department of General Physiology,
Marine Biological Laboratory,
Plymouth.
March 10.

[1] Adam, N. K., "Physics and Chemistry of Surfaces", 213 (1941).

Chemical Effects of Moonlight

The article by Dr. C. F. C. Beeson in *Nature* of October 26, p. 572, is a welcome attempt to sort out the many conflicting references to a subject of much importance and of wide interest. Numerous factors go to the growth of a plant, and I felt many years ago that it was necessary first to find out the chemical and physical effects of moonlight under simple controlled conditions. The research was carried out chiefly under the bright moonlight of South Africa. Moonlight is partially polarized, the maximum effect being with the oblique reflexion of half-moon, or somewhat later for the waxing and earlier for the waning moon.

The experiments were as follows :

(*a*) Exposure of seeds to the night sky at periods of half-moon and of no moon. There was marked increase of germination in those seeds in which the testa was thin and transparent. These experiments were simply exploratory but led to the inquiry as to the effect of moonlight on reserve food material.

(*b*) Exposure of starch grains, washed and mounted on a microscope slide, *without* a cover glass. No diastase was added, but the water contained 0·05 per cent sodium chloride as co-enzyme. After about three hours the slide was covered and left to dry. Crystals were seen forming within the grains and exuding from them, also in the surrounding film of liquid.

(*c*) Exposure of a film of *boiled* starch. On drying, crystals were seen forming stars and rosettes, and on treating with Fehling solution the change to a sugar was indicated by countless specks of cuprous oxide.

(*d*) In the living plant (chiefly in South Africa). Young leaves of *Tropæolum* and of spinach were partially covered by tinfoil, leaving a small portion exposed to the moonlight. In the exposed region the starch disappeared, while the covered portion still gave the blue colour with iodine. This effect was also shown in a shaded vine-leaf[1]. A similar effect can be produced on films of boiled starch on filter paper. A penny placed on top of a sheet of *thin* glass, with a film of starch on the under side, after exposure to moonlight, gave a distinct image of the shadow on staining the film with iodine.

(*e*) At the request of a consulting timber engineer, determinations of the sap content at different phases of the moon were commenced. Equal weights of vine stems were boiled and the solutions were tested for sugar after (i) a period of half-moon, (ii) after an equal period of minimum light. The result showed nearly twice as much reduction in the first case as in the second : (i) required 16·5 c.c., (ii) required 29·9 c.c. of the solution to reduce equal quantities of Benedict solution.

From these experiments, the results of which are similar to those obtained with artificially polarized light[2], it appears that moonlight, being polarized, has a hydrolysing effect on reserve food, that is, it acts as a digestive tonic. Now to live on digestive tonics, especially without extra food, may be disastrous—hence the conflicting results which have been recorded.

Most of the experiments referred to above are quite simple, and can easily be reproduced. They should help to dispel the idea of 'superstition' and 'old wives' fables'.

Elizabeth Sidney Semmens
West Grove,
Sandgate.

[1] *Nature*, **130**, 243 (1932).
[2] *Bot. Gaz.* (Dec. 1930). *Nature*, **144**, 379 (1939). Baly and Semmens, *Proc. Roy. Soc.*, B, **97** (1924).

RESEARCH IN BRITISH COLONIAL TERRITORIES

UNDER the title "Colonial Research, 1945–46" there have been issued (Colonial No. 208. H.M.S.O., London, 1947. 1*s*. net) the third annual reports of the Colonial Research Committee and the Colonial Products Research Council, the second annual report of the Colonial Social Science Research Council and the first annual reports of the Colonial Medical Research Committee and the Committee for Colonial, Agricultural, Animal Health and Forestry Research.

The year 1945–46 marked the completion of the main organisation and framework in London for the continuous survey of the needs of Colonial research, and the report of the Colonial Research Committee, after summarizing the arrangements made, appropriately takes stock of the results of some six years experience of the provision for research under the Colonial Development and Welfare Act, with which the Committee has been concerned since its creation in 1942. The cumulative total of research allocations under the Act now exceeds £1,000,000, and of 105 schemes made during the period since the Act came into force, 54 were made during the year 1945–46, when actual expenditure was £93,306 as against £58,345 in the previous year; the total expenditure to date is £202,565.

A main function of the Committee is to achieve the maximum degree of co-ordination of effort as between the various branches of science represented not merely by the bodies reporting in the present publication but also by the Economic Research Sub-Committee of the Colonial Economic Advisory Committee, the Colonial Fisheries Advisory Committee, the Tsetse Fly and Trypanosomiasis Committee, the Colonial Survey and Geophysical Committee and other specialist committees which are directly advisory to the Secretary of State for the Colonies. This task is being eased as there become available the long-term development plans of the various Colonies and regions with reference to the best use of the development funds available under the Colonial Development and Welfare Act. These plans indicate where the major efforts will be made and where in consequence a parallel research effort will be of the greatest value. Moreover, the Committee considers that studies of the bases of plans already formulated or being formulated are among the most fruitful objects to which a part of the research effort may be directed, and may constitute the essential foundation for fruitful research in many fields and for wise and efficient development planning.

While this report lists in an appendix the schemes recommended and finally approved during the period April 1, 1945–March 31, 1946, the Committee records progress only in those fields not covered by one or other of the specialist bodies. The report notes that it has now been decided to proceed with the scheme for establishing a central organisation for geodetic and topographical surveys, and Brigadier M. Hotine has been appointed director of Colonial (geodetic and topographical) surveys. The scheme, in which the Royal Air Force and the United States Army Air Force are participating, will allow the topographical mapping of large areas of the Colonies at a speed far in excess of anything achieved by ground methods before the War. It will also make available air photographs which can be of considerable value to forestry, agricultural and other officers in the Colonies in their ordinary work. Steps are also being taken to establish a Colonial geological survey on broadly similar lines, and work is expected to commence shortly on the preparation of plans for a freshwater fisheries research station on the shores of Lake Victoria at Jinja, Uganda, under a scheme to provide capital cost and running expenses for five years. Surveys of the Colonial fisheries in the Caribbean area have been completed, and plans are being drawn up for a fisheries research station for this area, which will probably be located in Trinidad. A further scheme provides a sum of £30,000 for the purchase and running costs for two years of a research vessel to investigate the fisheries of the Mauritius–Seychelles banks, which, it is hoped, will be in charge of Dr. J. E. Wheeler. Mr. J. S. Colman, lecturer in biology, University of Sheffield, completed a survey of the fisheries of St. Helena which suggested that policy should be directed towards improving the local supply of fish by means of better fishing methods and the improvement of distribution.

The Committee endorsed the recommendations of the report of the Colonial Housing Research Group for the establishment in Great Britain of a Colonial housing bureau for the collection and dissemination of information, to work in close association with the Building Research Station, and the establishment of housing research stations in the Colonies on a regional basis. It has also recommended the appointment in the Colonies of housing committees, representative of all the specialist interests concerned, and the appointment of an advisory committee in London; these proposals have been commended to Colonial Governments by the Secretary of State. As regards tsetse fly and trypanosomiasis, the main developments during the year were visits by Prof. P. A. Buxton, of the London School of Hygiene and Tropical Medicine, to East Africa, and by Prof. T. H. Davey, of the Liverpool School of Tropical Medicine, to West Africa, while the urgency of promoting experiments and research in the use of D.D.T. and other insecticides and repellents against tsetse led to a scheme for employing a Colonial Insecticide Research Unit in East Africa, for which a research grant of £41,500 over two years was made under the Colonial Development and Welfare Act. Arrangements were initiated for therapeutical field trials of phenanthridinium compounds. The Anti-Locust Research Centre has conducted extensive anti-locust campaigns with the usual methods of ground attack, but an Anti-Locust Flight of the R.A.F. has also been established with the object of exploring the possible use of aircraft; experimental operations in Saudi Arabia and in Kenya have justified further work.

In July 1945 a Land Tenure Advisory Panel was set up to advise on the general lines of research into native land questions and related matters; to review and co-ordinate the results of local investigations; to provide information for the Colonial Governments on systems of land tenure; and to advise on research aspects of general questions of land policy.

The third annual report of the Colonial Products Research Council also reviews general progress. Apart from research directly sponsored by the Council, notable progress has been made in encouraging and assisting workers already in the field, in effecting contacts and bringing new processes and discoveries to the notice of those who might be in a position to carry them further. A list of eight patent applications appended to the report illustrates the

extent to which work has already reached a stage ripe for industrial exploitation. Importance continues to be attached to the personal contacts between workers in Great Britain and in the Colonies. Dr. H. H. Storey, director of the East African Industrial Research Board, visited Britain and discussed proposals with the Council for setting that organisation on a permanent footing.

Work under Prof. T. P. Hilditch has greatly improved and simplified methods for analysing vegetable oils and fats, and a number of oil-seeds are at present under investigation, including Ceylon and Nigerian rubber seed oils and citrus oil seeds. The investigation under Prof. A. R. Todd into the nature of the active principle in the flowers of *Hagenia abyssinica* (*Brayera anthelmintica*) has been actively pursued, and a list of indigenous plants of the Colonial Empire of possible medicinal or insecticidal value has now been completed and circulated. Work has also been carried out on the exact determination of the pain-deadening power of drugs; a method evolved which will detect the action of as little as 5 mgm./kgm. of pethidine hydrochloride is being used in the examination of the analgesic action of sugar derivatives prepared in Sir Norman Haworth's laboratory. The Council is also planning an investigation of really adequate means of studying the action of drugs on intestinal parasites of man and beast.

Substantial progress has been made with the work on sisal carried out for the East African sisal industry under Prof. J. B. Speakman, and has thrown much light on the fundamental nature and properties of sisal. Pyrethrum research at the Imperial College of Science and Technology under Prof. J. W. Munro has been hampered by inadequate facilities. The Council has also considered the technical equipment of the St. Vincent arrowroot industry, and it is hoped to devise in Great Britain much more efficient extraction methods. A wide programme of researches on starch at the University of Birmingham includes further fundamental studies on arrowroot as well as on potato starch and those from cassava, pea and rice. A detailed study is being made of the enzymes present in potato starch, and work on the utilization of sucrose has been concerned mainly with the dianhydrides of mannitol and sorbitol, lævulinic acid and methylolfurfuraldehyde. The examination of the ester fractions of naphthenic acids from Trinidad has commenced under Sir Robert Robinson, and plans for the design of a Colonial microbiological research institute in Trinidad have been approved. Pending the completion of the new laboratory, Messrs. Glaxo Laboratories, Ltd., have offered Dr. A. C. Thaysen accommodation at Greenford, Middlesex, where work on micromanipulation, the growth curve of *Torulopsis utilis*, the organism used in food yeast production, and on the antibiotic action of an actinomycete which yields a substance capable of inhibiting the growth of *Fusarium oxysporum cubense*, a fungus responsible for Panama disease of bananas, is being carried out. Contact has been maintained with the Tin Research Institute.

The second annual report of the Colonial Social Science Council again refers to the need for sound demographic data, and to the necessity of establishing local and regional social research institutes, which can survey the needs of the regions in which they are located and assume responsibility for the supervision and organisation of individual research projects. The Council has accordingly approved a grant to enable the Rhodes–Livingstone Institute to extend its programme of work in Central Africa, and is co-operating in the appointment of a director and staff for the Institute of Social Research attached to Makerere College in East Africa. The end of the War brought a slight mitigation in the shortage of personnel trained for social investigation, and in the meantime the Council has continued to favour team-research involving collaboration between workers in different disciplines, partly because of the direct advantages of such co-operation, and partly because not all the members of the team need have had previous field experience. Specific projects approved during the period include studies of the legal aspects of land tenure in the Gold Coast, the political organisation of typical communities in the Gambia, mental illness and juvenile delinquency in West Africa, grammatical structure of Kikuyu, social and economic conditions in the Aden Protectorate, and the occupational structure of representative communities in the Gold Coast as influenced by war-time Government expenditure. The latter survey and a computation of national income, production and expenditure in Northern Rhodesia and Nyasaland are under the supervision of the Economic Research Sub-Committee.

The first annual report of the Colonial Medical Research Committee refers to the appointment of Dr. A. F. Mahaffy as director of the new Colonial Medical Research Service, and joint secretary, with Dr. F. Hawking, of the Committee. The Committee has recommended that the Service should be staffed with men recruited for whole-time medical research and organised and controlled from Great Britain; although men might be seconded from it for research in the Colonial laboratories staffed by the local governments. It is planned to make the terms of service at least as attractive as those of the Colonial Medical Service, with liberal allowance for leave to continue or develop medical researches in Britain, and arrangements for pension or superannuation facilitating interchange of personnel between the Service and academic appointments in Great Britain. The Committee has agreed that special attention should be paid, as soon as possible, to problems of nutrition; the control of malaria and mosquitoes by new anti-malarial drugs and by the new insecticides; and to filariasis, schistosomiasis, and the physiology of hot climates; but the general policy has been to try to obtain men of initiative and originality and to encourage them to choose their own problems and methods of approach. To encourage training of young men for such research and specialist appointments, the grant of up to ten Colonial medical research studentships to graduates of British universities has been recommended. A Malaria Sub-Committee has been set up and has given its first attention to field trials and similar investigations on the new antimalarial, paludrine. The organisation of therapeutic trials in the Colonies of new remedies has been discussed generally, and it has been arranged that such requests should be made first to the Committee; and, where approved, the trials organised in accordance with the general policy of the Medical Research Council. The Committee has recommended to the Indian Medical Liaison Committee for sympathetic consideration a proposal to establish a small testing station in the tropics for examining chemotherapeutic substances acting on microfilariæ *in vitro*. Proposals for research on the physiology of hot climates have been discussed with Dr. S. S. Ladell; investigation of the epidemiology of an outbreak of poliomyelitis in

Mauritius in 1945 indicated that the disease was endemic, there being malnutrition, overcrowding and increased prevalence of intestinal disease throughout the island at the time. The Committee has also recommended that it should accept the responsibility for taking over and staffing in two years time the research laboratories which the Rockefeller Foundation has established at Entebbe, Uganda, and Lagos, Nigeria.

The first annual report of the Committee for Colonial Agricultural, Animal Health and Forestry Research, established in June 1945, gives the detailed terms of reference of the Committee, which are determined so as to delineate clearly the functions as between the Committee and the Colonial Advisory Council for Agriculture, Animal Health and Forestry. Full co-operation is secured by overlapping membership and close contact between the secretariats of the two bodies. The Committee met seven times during the period and has set up a sub-committee on policy to facilitate consideration of basic policy. The most important matters before the Committee were the re-organisation and expansion of regional agricultural research in East Africa, and the organisation of oil palm research in West Africa; both raised the question of the distribution of research effort between basic and general problems of given regions and problems of particular crops of actual or potential economic importance. Generally, the Committee inclines to the view that the basic and general approach is the one which will be most fruitful in the long run, and it has also reached the provisional conclusion that institutions are required which can devote themselves without interruption to the study of long-term problems. Questions of personnel and terms of service as well as of the control of scientific work have also engaged the attention of the Committee, which hopes to present in its next annual report a clear statement of the general lines of policy which it is intended to follow.

REPORTS OF THE ATOMIC ENERGY COMMISSION

THE first report of the Atomic Energy Commission to the Security Council of the United Nations, dated December 31, 1946, includes first reports also on scientific and technical aspects of the problem of control and on the safeguards required to ensure the use of atomic energy only for peaceful purposes*. The Commission records its approval of the former report from the Scientific and Technical Committee and incorporates in its findings the conclusions of that Committee. A summary is given of the second report, also approved by the Commission, which has reached the further general finding that scientifically, technologically and practically, it is feasible to extend among all nations the exchange of basic scientific information on atomic energy for peaceful ends, to control atomic energy to the extent necessary to ensure its use only for peaceful purposes, to eliminate atomic weapons from national armaments and to provide effective safeguards by way of inspection and other means to protect complying States against the hazards of violations and evasions. Effective control of atomic energy depends at present upon effective control of the production and use of uranium, thorium and their fissionable derivatives.

* See *Department of State Bulletin*, **16**, 105 (No. 394, Jan. 19, 1947).

The development and use of atomic energy are not regarded as essentially matters of domestic concern of the individual nations, but rather have predominantly international implications and repercussions. An effective system of control must be international and established by an enforceable multilateral treaty or convention administered and operated by an international organ or operation within the United Nations, possessing adequate powers, and properly organised, staffed and equipped for the purpose. International agreement to outlaw the national production, possession, and use of atomic energy is an essential part of any such international system of control and inspection, although standing alone such agreement would be ineffective.

In accordance with these findings, the Commission recommends the establishment of a strong and comprehensive international system of control and inspection, the scope and functions of which should be defined by a treaty or convention, and which should become operative only when those members of the United Nations necessary to assure its success have bound themselves to accept and support it by signing and ratifying the treaty or convention. It is recommended also that the treaty shall include a clause to the effect that the rule of unanimity of the permanent members of the Security Council shall not relate to the work of the control agency, and that no Government shall possess any right of veto over the fulfilment by the agency of any of its obligations under the treaty. In addition to promoting the exchange of basic scientific information on atomic energy for peaceful ends and its responsibility for preventing the use of atomic energy for destructive purposes, the agency should have responsibilities for research and development in order to remain in the forefront of atomic knowledge. The exclusive right to carry on atomic research for destructive purposes should be vested in the agency, which should also establish appropriate safeguards for research in nuclear physics having a direct bearing on the use of atomic energy. Such safeguards should not interfere with the prosecution of scientific research, or the publication of its results, provided no dangerous use or purpose is involved. The treaty or convention should embrace the entire programme for putting the international system of control and inspection into effect and should provide a schedule for the completion of the transitional process over a period of time, step by step, in an orderly and agreed sequence leading to the full and effective establishment of international control.

At its meeting on March 10, the Security Council referred back to the Commission this first report with a request to prepare a draft treaty or convention, incorporating its ultimate proposals, and to submit a second report before the next session of the General Assembly. Mr. A. A. Gromyko's statement of the U.S.S.R.'s position, on March 5, ignored the Commission's finding that prohibition of atomic weapons would be ineffective except as part of a system of international inspection. He rejected the whole idea of inspection and of infringements of national sovereignty, and distorted the conception of the international control agency developed in the report, as well as the comments of the Council of the Atomic Scientists' Association on the American and Russian proposals before the Commission (see *Nature*, 159, 47; 1947) without advancing any constructive proposals to meet the difficulties he stressed. At the Security Council's meeting on March 10, Mr. W. R.

Austin vigorously refuted the allegation that the United States sought either a monopoly or to impose its will on other countries in questions of atomic energy. Referring to the Declaration of November 15, 1945, by the President of the United States and the Prime Ministers of the United Kingdom and of Canada, Mr. Austin said that the United States Government had made it clear that it welcomed all constructive suggestions which might advance the solution of the common problem and fulfil the mandate of the General Assembly resolution. Strong support for the United States position was forthcoming from the French delegation, and those of China and Australia.

HORMONES AND FRUIT-FALL

THE year 1939 marked the publication by F. E. Gardner, P. C. Marth and L. P. Batjer of their important discovery that the spraying of synthetic growth-substances on young apples prevented the natural shedding of fruit, which often reduced the crop quite substantially. These findings have been confirmed and expanded by many workers, and Dr. M. C. Vyvyan, of East Malling, has summarized the large amount of research which has been done on the subject*.

Fruit-drop has several causes. It may arise from structural defects, from non-pollination, from various types of non-fertilization, and from the abortion of embryos; nutritional conditions also seem important. One section of the bulletin considers the proportion of blossom which will become mature fruit, and another part records some of the variations in fruit-fall according to variety. The mechanism of abscission may, or may not, involve cell division, and these differing types of fruit-fall may be related to variations in response to growth substances. Certain naphthalene derivatives, for example, exert a marked effect on pre-harvest drop of many apple varieties, but have little or no effect in preventing 'June drop'.

A careful and detailed tabulation of extensive results allows certain generalizations. For the control of fruit-drop with most varieties, "nothing better than naphthaleneacetic acid or the acetamide seems to be required". Evidence on the optimum concentration is rather conflicting, but in most cases it is probably best to use the 'standard' concentration of 10 p.p.m. Temperatures between spraying and picking seem to influence the duration rather than the intensity of spray effect. Rain may be harmful if it falls before the spray has had time to dry. Sprays vary in their duration of effect; they are not, however, in general, effective until five or six days after application, and remain active for two or three weeks. The timing of treatment is therefore most important. Pure naphthaleneacetic acid and acetamide are sparingly soluble in water; they are accordingly dissolved in a little alcohol before dilution. The synthetic growth-substances may also be applied as dusts, though further work is necessary before such convenient applications can be recommended for general commercial use. Results reviewed by Dr. Vyvyan do not suggest that fruit retained on the tree by hormone sprays has markedly different storage characters from fruit ripened normally. Small variations do, however, occur, and further work is desirable.

This bulletin is an admirable summary of work on the control of fruit-fall. It provides new horticultural equipment for the fruit grower and should give direction and stimulation to further research on the subject. Fruit-fall is not, however, always an unmitigated evil, and while pre-harvest drop provides the clearest need for control by hormone sprays, the ultimate practical control of previous 'drops' may lie in an adjustment, earlier in the season, of the amount of blossom to nutritional potentialities of particular trees. This gentle warning provides no disparagement of the volume under review, for Dr. Vyvyan's text does not introduce synthetic growth-substances as a panacea for all troubles. They rather provide a welcome remedy for a specific difficulty.

JOHN GRAINGER

* Imp. Bur. Hort. and Plantation Crops, Tech. Comm. No. 18; obtainable from I.A.B. Sales Branch, Penglais, Aberystwyth (1946). 3s. 6d. net.

BIOCHEMISTRY IN BELGIUM

THE relative scientific isolation of the enemy-occupied countries during the War has engendered a determined post-war effort on the part of research workers of such countries to use with the maximum efficiency opportunities to contact workers in other countries. The appearance of publications reviewing the work of the past seven years in as wide a manner as possible is one outcome of this determination.

A series of short monographs is now appearing under the general title "Actualités Biochimiques", published (Liège: Éditions Desoer; Paris: Masson et Cie.) under the editorship of Prof. Marcel Florkin, of the University of Liège. The first of these, written by Prof. Florkin himself in 1945, is entitled "Aperçus sur les Progrès de la Biochimie, dans les Pays Anglo-Saxons, Depuis 1940", and represents a bird's-eye view obtained from visits in June 1945, made possible by Le Fonds National de la Recherche Scientifique de Belgique. This volume surveys work carried out in the United States of America as well as that in Great Britain, and covers an extremely wide field effectively, but in a manner which is necessarily somewhat superficial. The subject of British anti-lewisite (*B.A.L.*) is treated in a later volume (No. 8, published in 1947, entitled "Travaux Récents sur les Toxiques de Guerre"), by Prof. Z. M. Bacq, in which the well-known fascinating story is told with all due credit to the genius of R. A. Peters.

It is unavoidable that the standard of the volumes of this series should vary, since the outlook of the authors is widely different. The second of the series, entitled "Données Récentes sur la Nature et le Métabolisme de L'Os", by Prof. Marcel J. Dallemagne (University of Liège), is an interesting exposition on bone metabolism in which the physical properties are discussed in relation to functional biochemical aspects, and which includes a useful section on hormones. No. 3, on "L'Évolution du Métabolisme des Substances Azotées chez les Animaux", by Prof. Florkin, is a very useful summary of work which is widely scattered and difficult to come by within the covers of one volume, and it is a tribute to biochemists in Belgium that such an insistent interest is shown in comparative aspects of the subject. No. 4 is the first of more than one volume dealing with new methods of clinical analyses, entitled "Méthodes Nouvelles D'Analyse Biochimique et Clinique", by Ghislaine Duchateau (University of Liège), a subject on which it appears that more information will be given later. No. 5 (Pierre Fredericq) discusses "Données Récentes sur la Coagulation du Sang", while No. 6 deals with

"Acquisitions Récentes dans le Domaine de L'Enzymologie" (Prof. L. Massart). No. 7, by Claude Liébecq (University of Liège), is a useful discussion under the heading "Conception actuelle du Catabolisme de L'Hémoglobine".

The volumes announced for future publication include: "Données Récentes sur les Phosphatases", by Jean Roche and Nguyen-Van Thoai; "L'Acide Ribonucléique", by Jean Brachet; and "Données Récentes sur les Antigènes Bactériens. Constitution chimique et Propriétés Biologiques", by A. Boivin.

This series will be of interest not only to Belgian biochemists but also to all who wish to see a review of recent work provided in a concise form, which although it is by no means exhaustive, provides a key to the most important literature of the last seven years.

FORTHCOMING EVENTS

(*Meetings marked with an asterisk* * *are open to the public*)

Monday, May 5

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London W.C.2), at 5 p.m.—Dr. D. A. Spencer: "Recent Developments in the Application of Photography" (Cantor Lectures) (further lectures on May 12 and May 19).

SOCIETY OF CHEMICAL INDUSTRY (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6.30 p.m.—Annual General Meeting; Mr. E. Holmes: "Plant Hormones with special reference to Selective Weed Killers".

INSTITUTION OF ELECTRICAL ENGINEERS, LONDON STUDENTS' SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 7 p.m.—Mr. Arthur Duxbury: "The Presentation of Technical Information".

CHEMICAL SOCIETY, BIRMINGHAM BRANCH (in the Chemical Lecture Theatre, The University, Birmingham).—Mr. M. C. Paine: "Careers in Chemistry".

Tuesday, May 6

INSTITUTION OF CHEMICAL ENGINEERS (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 2.15 p.m.—Dr. B. A. Southgate: "The Re-Use of Waste Waters from Industrial Processes".*

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7 p.m.—Mr. D. A. Oliver: "Heat-Resisting Steels".

Wednesday, May 7

ROYAL AERONAUTICAL SOCIETY (at the Institution of Civil Engineers, Great George Street, London, S.W.1), at 11 a.m.—Discussion on "Naval Aircraft".

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London W.C.2), at 5 p.m.—Mrs. G. E. Abbott: "Gas in the Home".

INSTITUTE OF PETROLEUM (at Manson House, 26 Portland Place, London, W.1), at 5.30 p.m.—Major Kenneth Gordon: "The Development of Hydrogenation and Fischer-Tropsch Processes in Germany".

INSTITUTION OF ELECTRICAL ENGINEERS, RADIO SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Dr. E. A. Smith, Dr. E. Franklin and Mr. F. B. Whiting: "Accurate Measurement of the Group Velocity of Radio Waves in the Atmosphere, using Radar Technique".

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6 p.m.—Dr. R. R. Goodall and Dr. A. A. Levi: "A Microchromatographic Method for the Detection and Approximate Determination of the Different Penicillins in a Mixture".

INSTITUTION OF CIVIL ENGINEERS, NORTH-WESTERN ASSOCIATION (at the Engineers' Club, Albert Square, Manchester), at 6.30 p.m.—Annual General Meeting, followed by a Discussion on "The Contract System in Civil Engineering".

BRITISH INSTITUTION OF RADIO ENGINEERS, NORTH-WESTERN SECTION (in the Reynolds Hall, College of Technology, Manchester), at 6.45 p.m.—Mr. E. C. Cherry: "Single Side-Band Communication Channels".

Thursday, May 8

PHYSICAL SOCIETY (in the Physics Department, Imperial College of Science and Technology, Imperial Institute Road, London, S.W.7), at 4.30 p.m.—Annual General Meeting; at 5 p.m.—Prof. D. Brunt, F.R.S.: "Some Aspects of the Heat Balance of the Human Body" (Presidential Address).

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Mr. R. G. Vines and Mr. M. F. R. Mulcahy: "The Initial Stages of Explosion in Nitroglycerine"; Mr. R. G. Vines and Mr. M. F. R. Mulcahy: "The Propagation of Detonation in Thin Layers of Nitroglycerine".

LINNEAN SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 5 p.m.—Scientific Papers.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE (at Houghton Street, Aldwych, London, W.C.2), at 5 p.m.—Prof. Chi-Yuen Wu: "The General Economic Conditions and Future Development of China" (further lecture to be given on May 22).*

INSTITUTION OF ELECTRICAL ENGINEERS, INSTALLATIONS SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. C. F. Freeman and Mr. H. V. Mather: "Special Electrical Requirements of a Viscose Rayon Factory".

ROYAL AERONAUTICAL SOCIETY (at the Institution of Civil Engineers, Great George Street, London, S.W.1), at 6 p.m.—Mr. E. S. Moult: "The Development of the Goblin Engine".

WOMEN'S ENGINEERING SOCIETY, MANCHESTER BRANCH (at the Engineers' Club, Albert Square, Manchester), at 6.30 p.m.—Miss W. Hackett: "Capacitors—their Manufacture and Testing".

Friday, May 9

PHYSICAL SOCIETY, OPTICAL GROUP (in the Physics Department, Imperial College of Science and Technology, Imperial Institute Road, London, S.W.7), at 3 p.m.—Sixth Annual General Meeting; at 3.15 p.m.—Mr. E. W. H. Selwyn: "Photographic Resolving Power of Lenses".

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Prof. M. G. J. Minnaert: "The Fraunhofer Lines of the Sun" (George Darwin Lecture).

CHEMICAL SOCIETY, NEWCASTLE AND DURHAM SECTION (at King's College, Newcastle-upon-Tyne), at 5 p.m.—Prof. E. L. Hirst, F.R.S.: Bedson Club Lecture.

TELEVISION SOCIETY (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 6 p.m.—Mr. C. L. Hirshman: "Television Picture Quality".

UNIVERSITY OF GLASGOW (in the Chemistry Lecture Theatre), at 7.30 p.m.—Dr. Douglas Guthrie: "William Cullen and his Times" (other lectures in celebration of the Bicentenary of the Lectureship in Chemistry will be given on May 16, 23 and 30).*

Saturday, May 10

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, DIVISION FOR SOCIAL AND INTERNATIONAL RELATIONS OF SCIENCE (at the University, Manchester).—Conference on "The Place of Universities in the Community".*

Tuesday, May 6—Saturday, May 24

TOWN AND COUNTRY PLANNING ASSOCIATION (at the Institution of Civil Engineers, Great George Street, London, S.W.1).—Exhibition: "Thirteen Nations Plan for Better Living" (to be opened at 3 p.m. by Mr. Lewis Silkin).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

SENIOR ASSISTANT FOR ELECTRICAL ENGINEERING—The Principal, Municipal Technical College, Hopwood Lane, Halifax (May 10).

SENIOR POST IN THE ACOUSTICS SECTION of Research Department based in London—The Engineering Establishment Officer, British Broadcasting Corporation, Broadcasting House, London, W.1 (May 10).

EDITORIAL OFFICER—The Honorary Secretary, Society of Dyers and Colourists, 32–34 Piccadilly, Bradford, endorsed 'Editorial Officer' (May 10).

LECTURER IN SURVEYING in the Mining Department—The Registrar, The University, Leeds 2 (May 15).

CHAIR OF BOTANY in the University of Tasmania—The Agent-General for Tasmania, Golden Cross House, Charing Cross, London, W.C.2 (May 15).

HEAD OF THE SCIENCE AND TECHNICAL DEPARTMENT of the Norwood Technical Institute, Knights Hill, West Norwood, London, S.E.27—The Education Officer (T.1), County Hall, London, S.E.1 (May 17).

LECTURER (Grade II), an ASSISTANT LECTURER (Grade III), and an ASSISTANT LECTURER (temporary), in the DEPARTMENT OF PURE MATHEMATICS—The Registrar, The University, Liverpool (May 22).

LECTURER and an ASSISTANT LECTURER IN PHYSICS, a LECTURER and an ASSISTANT LECTURER IN CHEMISTRY, an ASSISTANT LECTURER IN ZOOLOGY, and an ASSISTANT LECTURER IN BOTANY AND ZOOLOGY (with special reference to Cytogenetics)—The Registrar, The University, Sheffield (May 24).

LECTURER IN BACTERIOLOGY, a SENIOR LECTURER IN PHYSICAL CHEMISTRY, and a LECTURER IN FUEL TECHNOLOGY—The Registrar, The University, Sheffield (May 24).

ASSISTANT LECTURER (Grade III) IN THE DEPARTMENT OF GEOLOGY—The Registrar, The University, Liverpool (May 27).

PROFESSOR OF GEOLOGY—The Registrar, University College of Wales, Aberystwyth (May 30).

PAINT ADVISER by the Government of Nigeria—The Director of Recruitment, Colonial Service, 15 Victoria Street, London, S.W.1.

LABORATORY ASSISTANT IN THE DEPARTMENT OF PHYSICS, and a LABORATORY ASSISTANT IN THE DEPARTMENT OF CHEMISTRY—The Registrar, University College, Singleton Park, Swansea.

ENGINEER with practical knowledge of drawing, design and development, a CHEMIST for physico-chemical research, and DEVELOPMENT OFFICERS (chemists or chemical engineers, preferably with some works experience)—The Director, British Launderers' Research Association Laboratories, Hill View Gardens, Hendon, London, N.W.4.

SENIOR LECTURER IN PHYSICAL CHEMISTRY—The Clerk to the Governors, Northern Polytechnic, Holloway, London, N.7.

PHYSICIST for research work in high-vacuum technique—The Director and Secretary, British Scientific Instrument Research Association, 26 Russell Square, London, W.C.1.

TEMPORARY POST in London with the Directorate of Ordnance Factories, Ministry of Supply—The Ministry of Labour and National Service, Technical and Scientific Register, Room 171, York House, Kingsway, London, W.C.2, quoting F56/47A.

LECTURER IN PHYSIOLOGY AND ZOOLOGY—The Registrar, Technical College, Sunderland.